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REPORT

OF THE

STATE ENGINEER

ON THE

CANALS OF NEW YORK,

With Compliments of

E. SWEET,

State Engineer and Surveyor.

TRANSMITTED TO THE LEGISLATURE, JANUARY 26, 1885.

ALBANY:
WEED, PARSONS AND COMPANY,
LEGISLATIVE PRINTERS.
1885.

STATE OF NEW YORK.

No. 38.

IN ASSEMBLY,

JANUARY 26, 1885.

ANNUAL REPORT

OF THE STATE ENGINEER AND SURVEYOR.

OFFICE OF THE STATE ENGINEER AND SURVEYOR,
ALBANY, N. Y., *January* 26, 1885.

Hon. GEORGE Z. ERWIN,
Speaker of the Assembly :

SIR — I have the honor to transmit herewith my report relative to the State canals for the fiscal year ending September 30, 1884.

Very respectfully,
your obedient servant,
E. SWEET,
State Engineer and Surveyor.

180435

REPORT

STATE OF NEW YORK:

Office of the State Engineer and Surveyor,
Albany, *January* 20, 1885.

To the Legislature :

In compliance with law I have the honor to submit to you the following report of this department for the past year:

1. Operations of the Canal.

The business of the canals has shared in the depression which has been common to all the industrial movements and enterprises of the country during the past year. The total amount of freight moved on the State canals during the season of navigation just closed was 5,009,488 tons, and comprised the following articles ; products of the forest 1,671,706 tons, products of agriculture 1,264,237 tons, products of manufacture 205,006 tons, merchandise 300,450 tons, other articles 1,568,059 tons. Total 5,009,488 tons.

This tonnage is less than that moved on the canals last year by 654,588 tons. Not only has the volume of canal freight diminished, but the rates of freight have been unprecedentedly low during the last season. In both these respects, however, the canal business suffers in common with the railroads which compete for the same freights and to whose warfare among one another may be attributed the lowest freight tariff ever known.

The reported operations of the New York Central Railroad for 1884, shows 688,024 tons less freight than in 1883, and the New York and Erie 2,538,685 tons less freight than in 1883.

A new railroad line, the West Shore, competing for the same business has, however, been opened within the past year, but its whole tonnage was much less than one-third the loss of freight suffered by the Central and the Erie roads.

The average rate of freight on these roads for all classes of articles shipped was, in 1884, .740 of a cent per ton per mile, against .845 of a cent per ton in 1883. The average rate of canal freight during 1884, was .27 of a cent per ton per mile against .340 of a cent per ton in 1883. The canal has suffered and the public temporarily gained by one of those periodic railroad wars brought on in part by new rivalries and in part by the fact that the meager crops in 1883 and the bad market of 1884 made the volume of business too small to permit them all to be prosperous and contented. The total earnings of all the railroads of the State for the past year have been in round numbers $126,204,000 against $133,980,000 for 1883. The charges against earnings other than dividends were for 1884, $118,800,000 against for 1883, $114,027,000. Thus the earnings decreased $7,576,000, and the expenses increased $4,473,000, showing an aggregate loss compared with the operations of 1883, of $12,549,000, or nearly ten per cent of the gross operations of the railroads of the State, though over $44,000,000 had been added to the railroad capital in the State during the year.

The following table shows the tonnage of the canal and of the railroads competing with the canal for the last twenty years:

Table showing the annual tonnage of the canal and competing railroads from 1865 to 1885:

	Canal — Tons.	Railroads — Tons.
1865	4,729,654	3,609,640
1866	5,775,220	4,844,989
1867	5,688,325	5,152,472
1868	6,442,225	5,754,842
1869	5,859,080	6,594,094
1870	6,173,769	8,974,505
1871	6,467,888	9,376,264
1872	6,673,370	9,958,239
1873	7,364,782	11,835,426
1874	5,804,588	12,478,954
1875	4,859,858	12,241,900
1876	4,172,129	12,776,498
1877	4,955,963	12,533,807
1878	5,171,320	13,845,981
1879	5,362,372	17,228,394
1880	6,457,652	19,248,930
1881	5,179,192	22,678,202
1882	5,467,423	23,225,631
1883	5,664,056	24,503,063
1884	5,009,488	22,123,895

It must be borne in mind that the average haul of rail freights is much shorter than those by canal; the former on the through New York lines average considerably less than 200 miles, while the canal freights, being mostly through, are at least twice as long so that a table of gross tonnage does not fairly represent the comparative business of the routes and favors the railroads to the extent of about fifty per cent. .

These statistics, though they show that the canal has ceased to occupy the leading position as a freight carrier which it held twenty years ago, indicate a uniformity and persistence in the volume of its business, illustrating forcibly the importance of water carriage when we consider that during this period the development of railway transportation has absorbed the skill and resources of the engineering profession, the best executive and administrative talent, and so much of the capital of the country, while the canal has remained unimproved and unchanged as to its structure, its equipment and its modes of operation.

2. NAVIGATION.

The canals were opened on the 6th day of May and closed on the 1st day of December, 1884. With the exceptions of the detentions due to the breaks hereafter described and the scarcity of water on the Rome level occasioned by the lack of storage capacity at Forestport, the navigation of the canals has been uninterupted during the last season, as is shown by the unusually quick passages made by boats during the season.

3. WATER SUPPLY.

Owing to the diminished summer flow of the streams supplying water to the middle and eastern divisions, and the fact that nearly all the streams flowing from the water sheds available for their supply have been brought under contribution and have for several years barely sufficed to keep the levels supplied, the subject of water supply has become of vital importance. Though very thorough methods were adopted to stop the leaks in the Glens Falls feeder by which a considerable portion of the water discharged through that feeder for supplying the Champlain canal has heretofore been lost, it was necessary for several weeks during the past summer to use the whole available supply of water from Glens Falls, and I am of the opinion that the recommendation of the Superintendent of Public Works for the erection of one or more reservoirs on the upper Hudson, to be under the control of the State, should be carried out without delay.

On the western division, although the supply from Lake Erie is practically inexhaustible, the extent of canal fed from that source is so long as to make the assurance of a sufficient supply on the eastern portion of that division dependent on an unobstructed channel.

The difficulties which have been experienced in keeping this part of the canal fully supplied of late years result chiefly from the sedimentary deposits in the prism, the growth of aquatic plants and the existence of a pier at the draw-bridge at Albion, all of which contract the water-way and impede its flow.

I heartily concur in the recommendations of the Superintendent of Public Works for removing these obstructions. During the past summer considerable detention was occasioned on the Rome level of the Erie canal from the lack of water and the time required to make the reservoirs which feed this level available.

The construction of the dam and reservoir at the head of the Forestport pond, on the Black river, by which a large supply of water will be saved and the saving of thirty-six hours effected in the transmission of water to this level of the canal, for building which an insufficient appropriation has already been made, should, as recommended by the Superintendent of Public Works, be provided for at the earliest practicable moment.

4. THE CONDITION OF THE CANAL.

Though there is undeniably a gradual deterioation of the structures of the State canals, comparing the result of a careful inspection of their condition during the past year with the result of my examination of them ten years ago, as the expert engineer of the Canal Investigating Commission, I am of the opinion that they have suffered no change, materially impairing their efficiency during that period, and that no considerable extraordinary expenditure will be required to maintain their present efficiency for many years.

The general condition of the perishable structures has been fully maintained, if not improved.

The building and use of twelve additional scows by the Superintendent of Public Works during the past year for gravelling the tow path, has produced a very marked improvement and the methods he has adopted by the concentration of mechanical work in large shops has resulted in great economy in the maintenance of the mechanical structures.

5. IMPROVEMENTS IN PROGRESS.

Under special acts of the Legislature there are now in progress the following extraordinary improvements: 1. The lengthening of lock No. 50, near Syracuse, to double its former length for the purpose of permitting coupled boats to be locked without detention. 2. The construction of an iron bridge across the Erie canal at Medina. 3. The construction of an iron bridge across the Champlain canal at Watervliet. 4. Rebuilding of Burden's waste-weir on the Champlain canal at Waterford. 5. Building a spill-way between locks 5 and 6 on the Champlain canal. 6. Rebuilding the waste-weir above lock No. 11 on the Champlain canal. 7. Rebuilding a culvert three-quarters of a mile south of Fort Miller lock on the Champlain canal. 8. Rebuilding bridge at the foot of the Glens Falls' feeder on the Champlain canal. 9. Rebuilding Eastman's waste-weir on the Champlain canal near Whitehall. 10. Constructing seven bridge abutments on the lower section of section No. 1 on the Champlain canal. 11. Improvement at the sloop lock pier of the Troy dam. 12. Rebuilding culvert at Thorn's Lane on the Champlain canal. 13. Rebuilding waste-weir at lock 20 on the Champlain canal. 14. Minor improvements at over twenty different places on the Champlain for the purpose of rectifying its curvature, widening its prism and strengthening its banks. All these works of extraordinary repairs on the Champlain canal are being effected under chapter 301 of the Laws of 1884, re-appropriating certain funds for the improvement of this canal and they will suffice to put its mechanical structure in good condition and greatly increase the facility and security of its navigation.

6. THE WEST SHORE RAILWAY.

The West Shore Railway for more than eleven miles of its extent is built alongside the Erie Canal and encroaching upon the State land. Its construction upon this location was authorized by permits granted by the Superintendent of Public Works under stringent regulations as to its method of construction. The requirements of these permits have not in all cases been fully complied with as yet; the amount still remaining to be done is not of very great magnitudes and when fully completed will effect a permanent improvement of the portions of the canal along which the railroad runs, as under these permits the railroad company are required to permanently widen the canal and protect its banks with permanent structures.

7. THE ALBANY BASIN.

The Albany Basin was built and for many years used as the eastern terminus and harbor for the State canals. For many years, however, all through eastern freights have gone directly to destination at the seaboard without breaking bulk, so that the eastern terminus of the canal has been transferred from Albany to the port of New York. As a consequence the Albany basin has long been in disuse for canal purposes and ceased to be of interest to the State. So long, however, as it remains under the State's jurisdiction it should not be permitted to become a nuisance to the citizens of Albany where it is located, and the Legislature should provide the necessary means for keeping it cleaned out. As the report to you of the State Board of Health clearly shows, it is now in a very disgraceful sanitary condition.

8. ADIRONDACK LANDS.

At the request of the Commission appointed by the Comptroller to investigate and report a system of forest preservation, the State Engineer has caused a map of all the public lands in the Adirondack region to be compiled from the records in his office and the office of the Comptroller.

Such a map seemed to be necessary to enable those Commissioners to even begin their labors.

Though the State in the past twelve years has appropriated over $100,000 for the ostensible purpose of securing accurate surveys and maps of this Adirondack wilderness, no map of any value upon which any reliance could be placed by these Commissioners was found to exist. As there were no other available funds for meeting the expenses of making the map compiled by me, it has been paid for from the fund appropriated for the purposes of the Forestry Commission.

The map is of permanent value to the Land and Tax Departments of the State and the cost of making it is not properly chargeable to that fund but should be provided for by special appropriation.

9. THE ENGINEERING DEPARTMENT.

In addition to the ordinary duties of the staff of the engineering department connected with the canals, they have had charge of the improvements at the Buffalo Asylum for the Insane, authorized by Chapter 488 of the Laws of 1884; they have made the surveys, levels and maps required by concurrent resolutions of the Assembly, relating to improvements of Flint Creek in Ontario and Yates counties, and to the establishment of benches, and the observation of the different stages of water in the Seneca river, a report of which is attached hereto, and have made all the surveys and maps, and given such expert testimony as was required in protecting the interests of the State before the Court of Claims.

A tabular statement of the expenditures of the department, and the personnel of the engineering staff, will be found in the report of the division engineers attached to this report.

In this connection, I may be permitted to reiterate the protest of some of my predecessors to certain encroachments on the province assigned to the office which I have the honor to hold, by establishing independent bureaus to conduct surveys for the State, and which seem to me to be prejudicial to its dignity, and prejudicial to a simple and efficient administration of the engineering branch of the public service of the State.

The laws defining the functions of the State Engineer and Surveyor, beside the supervision of the engineering matters pertaining to the public works, devolve on him the duty of superintending the survey and sale of the State lands, settling all disputed internal boundaries, and direct him to collect and preserve all maps, plans, drawings, levels and surveys of every description made or to be made for the use of the State.

The evident intent of founding this office was to create a department having complete jurisdiction over all engineering and surveying subjects in which the State was concerned. To divide this jurisdiction, and scatter these functions among independent commissions and bureaus, degrades the dignity of this constitutional office, and is inconsistent with responsible, efficient, harmonious and economical administration, besides scattering the engineering records of the State, of which this office is the legal depository.

Though the State survey and its prototype, the Adirondack survey, have been in operation nearly ten years, yet there is not an official record in this office relating to either, except the protest of my predecessors against their independent continuance.

Those who plead for a special treatment of this part of the State's work ignorantly magnify its difficulty, because it is one of the simplest fields entered by the civil engineer, and they underrate the popular intelligence, and forget the Civil Service Law, when they express fear that it will be mismanaged under an elective office.

The economy of having all the State's engineering operations con ducted under one responsible head is obvious, aside from the consideration that all bureaus, organized to accomplish particular objects, have an incurable tendency to magnify and prolong their mission.

Though a great deal of ignorant and inconsiderate matter has been said and written in favor of this work, a careful survey that will furnish the basis for an accurate map of our State is of very great importance and should be prosecuted to completion.

We should not, however, allow ourselves to be deluded as to the full significance of the undertaking.

The trigonometrical survey by which the State is being covered with a series of connected triangles, forms only the basis or skeleton of the work, and is utterly useless to the map maker, and practically so to the local surveyor, or any one else until filled in with a net work of linear surveys, serving to locate the more important political and artificial boundaries which subdivide, and the natural and artificial objects which characterize and diversify its surface.

This is a work of considerable magnitude, but no civilized State can afford to forego it, and under whatever management it be conducted, it should be more liberally supported, in order that it may be progressed in a far more energetic and business like manner than has thus far been done and to bring its cost within reasonable limits, and to make its results available to the next generation.

10. THE CANAL PROBLEM.

To all who have studied the comparative statistics of railway and canal commerce for the last few years it must be apparent that the canals are fast losing their prominence as a factor in the problem of transportation. That they still exercise and may be confidently expected for many years to continue to exercise a salutary influence in the regulation of freight tariffs there can be no doubt. But it is quite as evident that in their present condition they can never again play the prominent part in internal commerce that they did twenty years ago.

There are two methods of improving the Erie canal and in my opinion only two worthy of consideration.

The first is to increase its depth one or two feet by such deepening of the channel and raising of the banks as is consistent with maintaining the integrity of its present structures and to lengthen the locks to facilitate the use of steam by permitting boats to be locked in pairs. This system of improvement would give the best attainable result for the boats now in use and to the consort system of steam towage for their movement.

The second method is to enlarge it to such an extent as to make it available for the steamers navigating the lakes a class, of vessels of large tonnage and moderate power and speed, which are rapidly displacing all other merchant marine for freight traffic on the lakes and on the ocean.

Any compromise scheme of improvement greater than the one first above mentioned and less than the last would necessitate a new and independent marine for the canal and the delay and expense of breaking and transferring cargo which is the fatal trouble with canal business now, and must in the nature of the case be a flat failure.

If the method of improvement first described had been adopted eight or ten years ago when first advocated by intelligent friends of the canal, it would probably have insured the general adoption of the steam consort system and sufficiently shortened the time and economized the cost of freight service by canal as to have greatly increased and prolonged its usefulness and importance.

But the march of time and events has brought about such economies in other means and routes of transportation that the minor improvement, I have suggested, is in my judgment already inadequate to meet the present and prospective wants of the northwestern commerce seeking the east and the sea and that the more radical and extensive improvement is needed.

To describe the radical improvement of the Erie canal which I have mentioned and which I believe to be of incalculable importance to the State and city of New York, I take the liberty of quoting from my paper on the subject read before the American Society of Civil Engineers in June last:

"It is clear to me that the Erie canal, to become the permanent highway of this commerce, must have sufficient capacity to float the largest vessels navigating the great lakes from Lake Erie to the deep waters of the Hudson, and in view of the fact that the draught of the lake vessels is now limited by the dimensions of St. Mary's and St. Clair canals, which may hereafter be enlarged, the locks of our canal should be large enough to provide for the probable increase in the size of lake vessels.

"The canal should be at least eighteen feet deep and 100 feet wide at bottom, and its locks should be 450 feet long and sixty feet wide. The successful operation of the canal thus enlarged requires that it should receive its water from the lake and discharge it into the Hudson, on account of the insufficiency of water tributary to its route to supply it.

"This and various topographical and economic considerations render a radical change in parts of the route and profile of the old canal essential.

"These changes are entirely practicable and involve no very serious difficulties.

"The essential change in profile consists in extending the Rome level westward to lock 57, between Newark and Lyons, in Wayne county, throwing out the locks 47 to 56, inclusive. This change in profile can be effected by swinging the route to the southward, near Newark, crossing the Canandaigua outlet and occupying ground of the proper elevation along the south side of Clyde river, and crossing the Seneca river at the narrowest part of its valley, which is near its junction with the outlet of Cayuga lake, from where it should gradually approach the present route of the canal, and connect with or cross it just east of the city of Syracuse.

"The only serious difficulty encountered on this route is the crossing of the Seneca river, where the water surface of the canal must be nearly fifty feet above that of the river, and for nearly two miles over forty feet above the surface upon which its embankment must be built.

"This change of route, to secure a continuously descending profile from the lake to the Hudson river, is the only deviation from the route of the old canal that is absolutely necessary; but I think the construction would be simplified and cheapened, and the best possible water-way secured, by the adoption of an entirely new route from Syracuse eastward.

"Lower ground can be obtained for the Rome level, except at the summit itself, by moving the line northward, thus, by lowering the elevation of this level throughout, lessening the difficulties of the Seneca river crossing, and from a point a little west of Utica eastward to the Hudson the Mohawk river should by canalized by the erection of locks and movable dams at suitable points in its course, and the deepening and rectification of its channel.

"From the mouth of the Mohawk, at Troy, to the deep water of the Hudson river, below Coxsackie, that river must be improved by narrowing and deepening its channel, or a canal must be constructed along its shore. The former method of construction affords, in my judgment, the simplest and most useful means of securing the desired results.

"The plan may, therefore, be summarized as the widening, deepening and necessary rectification of the worst curvatures of the present canal, from Buffalo to Newark, about 130 miles, the construction of a new canal from Newark to Utica, about 115 miles, the canalization of the Mohawk River from Utica to Troy, about 100 miles, and the improvement of the Hudson River from Troy to Four Mile Point, in Coxsackie, a distance of about thirty miles.

"The elevation of the western level of the canal being governed by the surface of Lake Erie, must secure the required depth wholly by deepening, while the profiles of the levels from Lockport east can be adjusted to meet the economical requirements that will be disclosed by detailed surveys.

"The first level from Buffalo to Lockport, will be thirty-two miles long. Descending from this level at Lockport, by two locks, each of about twenty-five feet lift, the second level of the canal will be reached. This level, sixty-four miles in length, will extend to Brighton, where, descending by two locks of about twenty-four feet lift, we reach the third level of the canal, extanding from Brighton to Macedon, twenty miles, there descending by a lock of about twenty feet lift, we reach the fourth level, extending from Macedon to Newark, twelve miles; where, by a lock of about twenty feet lift is reached the level of the proposed new canal, to extend from Newark to Utica, about 115 miles, which will be the fifth and longest level of the new canal. From that point the Mohawk River (except at Little Falls and Cohoes, where combined locks will be required) can best be canalized through locks of ten or twelve feet lift, making pools having an average length of about five miles each.

"The construction of this great artificial river, more than 300 miles long, involving as it does so vast a structure, which must be built in a manner to attain absolute security and permanence; the aquisition of large areas of land; the maintenance of the drainage of the country it traverses, and the eroction of swing bridges at all necessary crossings, is a vast enterprise, both in engineering and in finance. It is a problem, however, that cannot be accurately stated even, either in a financial or in an engineering sense, until detailed surveys furnish data for detailed plans and estimates, and until a careful compilation of industrial statistics furnishes the means of judging the volume of tonnage it will probably command.

"The first requisite to the possible inauguration of this enterprise is, of course, a careful system of surveys that will determine its probable cost, and whether it be undertaken by private enterprise, as most of the great artificial transportation lines of the world have been, by the aid of the National Government, or by the State itself, every consideration of State interest and State pride requires that it, should remain forever under the sovereign control of the Empire State."

" Deeply impressed as I am, with the importance of this subject I respectfully commend to the Legislature the propriety of authorizing and providing for the necessary surveys and estimates to be made for determining the elements of this problem.

" Let us consider the effects of this improvement. For the past four years the average grain rates from Chicago to New York during the season of navigation have been by rail 14$\frac{9}{10}$ cents, by lake to Buffalo and thence by rail to New York, 12$\frac{1}{10}$ cents, and by lake and canal to New York, 9$\frac{9}{10}$ cents per bushel.

The large propellers of the lakes have, however, during this period, found a profit in carrying grain from Chicago to Buffalo at two cents a bushel, while the cost by canal from Buffalo to New York, though the distance is only half as great, without tolls, but including the cost of transfer has, at the same time, been more than four cents per bushel, more than twice the cost, and more than twice the time in transit for one-half the distance.

In the enlarged canal, making due allowance for reduced speed in the narrow channel and for lock detentions, the propeller would make the trip from Buffalo to New York in as short a time as she requires between Chicago and Buffalo, and thus deliver her cargo from Chicago to New York in less time and at less cost than can now be done by canal from Buffalo to New York. Such a realization would establish the commerce of New York on an enduring basis, never to be shaken by any development of trade, or combination of circumstances, that now seem possible.

All the great railway systems of the west, north of Arkansas and Texas, terminate at lake ports, and their prosperity and very existence depend on the diversion of all the business they can control to these ports, and with this canal enlarged, all the heavy freights that reach those ports, bound east, are destined by the laws of trade to take the water route, as being cheaper than any rail transit yet dreamed of. Within the net-work of these railway lines, or grouped about the great lakes themselves, lay the great grain fields of the country, its principal forests and mines, as well as the chief part of its inland cities.

They must all become tributary to this canal if enlarged, and offer in commodities suited to canal transportation a larger volume of tonnage than the world has ever seen concentrated on an artificial line of transportation.

The importance of this enterprise increases with the rapid growth of our population, and the consequent changing social and economic conditions of the country. Our productive capacity is beginning to exceed the demand. Our foreign grain markets are threatened with new competion from India and Australia.

If our national prosperity is to continue, we must reach foreign markets with our manufactures, and thus, by increasing the manufacturing class, create new home demands for our surplus food.

To reach these markets, we must cheapen the goods by lessening the cost of living to the operatives, and also the cost of bringing to gether the raw materials requisite to manufacturing processes, and of sending the manufactured products to market.

With our wide-spread territory, cheap transportation is the chief agency in effecting these economies, and the Erie canal, joining the granaries, the mines and the forests of the west, with the manufactories of the east, should be endowed with the necessary capacity to effectually realize the ideal of the political economist as to transportation."

Respectfully submitted,

E. SWEET.

SUMMARY of engineering expenses for the canals during the fiscal year ending September 30th, 1884.

EASTERN DIVISION.

For ordinary repairs, Erie canal	$5,121 71	
For ordinary repairs, Champlain canal	983 04	
For incidental expenses	703 68	
Total		$6,808 43

MIDDLE DIVISION.

For ordinary repairs, Erie canal	$4,183 71	
For ordinary repairs, Oswego canal	1,011 47	
For ordinary repairs, Cayuga and Seneca canal	1,155 26	
For ordinary repairs, Black river canal	400 08	
Total		6,750 52

WESTERN DIVISION.

For ordinary repairs, Erie canal	$5,806 70	
For incidental	546 75	
Total		6,353 45
Total engineering expenses for ordinary repairs		$19,912 40

EASTERN DIVISION.

Expended for extraordinary repairs, under chapter 301, Laws of 1884, reappropriating $201,283.66 for improving the Champlain canal	7,555 67

MIDDLE DIVISION.

Expended for extraordinary repairs	160 20
Total engineering expenditures	$27,628 27

IN MEMORIAM.

At a meeting of the State Officers and Staff of the Engineering Department held at the office of the State Engineer in Albany, December 4, 1884, as a tribute of respect to the memory of Charles Hilton, late Deputy State Engineer and Surveyor, the following memorial was unanimously adopted:

The attaches of the State Departments have heard with deep regret of the death of their late associate, Charles Hilton, Deputy State Engineer and Surveyor. Actuated by a high appreciation of the nobility of his character, they affectionately place this memorial upon record:

Mr. Hilton early in life embraced the profession of civil engineering for his life work, and by assiduous industry, assisted by natural abilities of a high order, early attained distinction in it and has left in the great number of important engineering works designed and executed by him, lasting monuments of his professional skill and ability. He was a man of firm convictions and of unimpeachable integrity, whose official life was marked by a high sense of the responsibilities, and a faithful and conscientious discharge of the duties imposed upon him. Free from prejudice, he was to all men a gentleman, while his intercourse with his associates in the State's service was distinguished by a suavity of manner and a pleasantness of speech which endeared him to them with more than ordinary affection. Indeed, so warm and generous were the impulses of his heart that to know Mr. Hilton was to be admitted to a share in his friendship. Expressing our heartfelt sorrow at the death of so good a man and impressed with a profound sympathy for his afflicted family, it is

Resolved, That as a public mark of our regard for his memory, we attend his funeral in a body, and that these proceedings be published in the city papers.

E. SWEET,
Chairman.

J. P. MASTERSON,
Secretary.

EASTERN DIVISION.

Annual Report of the Division Engineer, New York State Canals, 1884.

Albany, N. Y., *October* 1, 1884.

Hon. E. Sweet, *State Engineer and Surveyor :*

Sir — I have the honor to transmit herewith my annual report for the fiscal year ending September 30, 1884.

Yours respectfully,
John R. Kaley,
Division Engineer.

Description of the Eastern Division.

The limits of this division remain as fixed by the Canal Board, in February, 1876.

It embraces the Erie canal from Albany to the east line of Oneida county, and the whole of the Champlain canal, including their basins, side cuts, river improvements and feeders.

The canal is entered from the river at its terminus through Lock No. 1, also by two side cuts, one at Port Schuyler, and the other at West Troy, the connection at Albany and West Troy being with double locks, and at Port Schuyler by single lock.

This division also embraces the Champlain canal from its junction with the Erie at West Troy to Whitehall together with the Glens Falls feeder, from where it joins the Champlain, one mile north of Fort Edward to the feeder-dam in the Hudson river, two miles west of Glens Falls, including also the pond extending five miles above this point together with the pond above the Troy dam and the Waterford side cut.

The Champlain canal is entered from the Erie at West Troy and from the pond in the Hudson at Waterford through the side cut.

The number of miles of navigable canals and river improvements on the Eastern Division is as follows:

	Miles.
Erie canal, Albany to Utica	106.243
Port Schuyler side cut	.35
Albany basin	.77
Champlain canal, including Waterford side cut and Cohoes and Saratoga dams	66.00
Pond above Troy dam	3.00
Glens Falls feeder and pond	12.00
Total	188.363

Extent of feeders not navigable.

	Miles.
Mohawk river at Rexford Flats	.39
Mohawk river south side, Little Falls	.19
Mohawk river at Rocky Rift	3.92
Schoharie creek	.63
Total	5.13

Erie Canal — Water Supply.

The Erie canal upon this division is supplied with water from the following sources:

That portion of this division west of Little Falls is supplied from reservoirs and streams on the Middle Division, through the Rome level. At Little Falls the supply is through the feeder from the Mohawk river, entering the canal through the tow-path, about sixty feet below Lock No. 39.

Near Mindenville, the supply is through Rocky Rift feeder from the Mohawk river, discharging into the canal through the tow path, four hundred feet below Lock No. 34.

Near Fort Hunter, the supply is from Schoharie creek, discharging into the canal on the berme side, about four hundred feet below Lock No. 29.

At Rexford Flats, the supply is from the Mohawk river, entering the canal through the tow-path, about one hundred and twenty feet below Lock No. 21.

Notwithstanding the large amount of waste at Little Falls and at Schoharie creek, in consequence of the dilapidated condition of the feeder-dams at those points, the water supply on this division of the Erie canal has been uniformly good, and the levels generally kept fully up to their proper elevation.

Champlain Canal — Water Supply.

The water supply of the Champlain canal is principally from the Hudson river through the Glens Falls feeder, discharging into the summit level of the Champlain canal, supplying the canal from Fort Ann to Whitehall, being supplemented on the north by waters of Wood creek. Also from Northumberland to the first lock north of Waterford, the supply is from the Hudson river entering the canal at Northumberland, and from the last-mentioned lock to the Erie canal, including the Waterford side cut, the supply is from the Mohawk river.

The water supply on this canal during the past fiscal year has been equal to the demand.

Wide waters may be secured both on the Erie and Champlain canals, making reservoirs of considerable size and at comparatively small expense, except the items of land damages, by removing the berme bank and allowing the water to flow back to the foot of the hills thus enlarging the prism and securing wide water at many points.

On the Champlain canal by cutting off bends in the tow-path the alignment may be very much improved, the prism enlarged and the water supply increased. Many improvements of this description have been made duing the years of 1883 and 1884, which will be described more fully in this report.

Erie Canal — Dams.

No. 1. Located at Rexford Flats, Schenectady county, across the Mohawk river known as the upper Aqueduct dam. This dam is of cut stone on a rock foundation, has a crib apron of timber and stone; the length of the dam proper is 675 feet and it is seven feet high. There is a fishway in this dam and each year it becomes necessary to repair damages to the same caused by spring freshets. The dam proper is in good condition, the feeder bulkhead at the arch passing under the canal should be rebuilt. The fishway has been repaired.

The head of the feeder is situated several hundred feet up stream from the upper Mohawk Aqueduct and passes through a large culvert under the canal between the aqueduct and Lock 22, discharging into the level below Lock No. 21.

No. 2. Located near Fort Hunter, Montgomery County, across Schoharie Creek, known as the Schoharie Creek Feeder Dam; is constructed of timber cribs filled with stone and covered with timber. The length of the dam proper is 575 feet, with cut stone abutments.

The crib work and covering are much worn and should be repaired.

No. 3. Located about five miles east of Little Falls at Castle Creek, Herkimer County, over the Mohawk river and known as Rocky Rift Feeder Dam.

The dam and abutments are of cut stone on a rock foundation. The length of the dam proper is 600 feet. The crest of the dam is too low and should to be raised about two feet. I would recommend raising the dam and abutments; raising a dam by means of a two foot course of masonry laid upon and bolted to the present coping. In seasons of low water it becomes necessary to use about two feet of flash boards to secure the necessary elevation of water.

No. 4. Located at Little Falls, Herkimer County, across the Mohawk river is composed of logs, brush, and gravel, has abutments and bulkhead of cut stone with two lock gates. The dam proper is about 770 feet long; 490 feet north and 280 feet south of a small island situated at the head and dividing the same.

I would recommend that a new dam of stone be built somewhat below the present structure, where the length would not exceed 500 feet, and to use in the construction of the same the stone from the abandoned aqueduct at Little Falls, thereby materially reducing the cost.

Erie Canal — Locks.

There are forty-seven double locks on this division of the Erie canal, two of which are on the West Troy side cut, also two single locks combined on the Port Schuyler side cut, the two last mentioned connecting the canal with the Hudson river at these points; there are also two weigh locks, located at West Troy and Albany.

All are enlarged, being 110 by 18 feet each in the chamber with various lifts, as shown by the accompanying table. The forty-five locks situated on the main canal from Albany to the east line of Oneida County have a total lift of 425.4 feet above tide water. Locks 37 and 44 have tumble gates at upper end; Lock No. 39 has a tumble gate in berme lock; the rest all have mitre gates. Those of Lock No. 37 are all operated by water power machinery also the tumble gates in Locks Nos. 39 and 44.

The locks on this division are for the greater part in good condition and need very little repairs. The most important recommendation I have to make is, that where needed they should be thoroughly pointed with Portland cement; the joints being well cleaned and the cement well caulked in the joint. I would also recommend that, as a matter of economy to the State, the face stone of all new lock masonry be laid in a mortar of Portland cement; this has been tested on canal work and with success.

The ring stone of the arch at Lock 24 should be replaced.

The upper berme Lock No. 43, at Mohawk, should have the bottom under the apron and the well at the lower end of the lock concreted and replanked, the same having been washed out and temporarily repaired during the year.

There has been more or less work performed on the locks in the way of general repairs to the foundations, gates and paddles, pointing masonry, etc., which cannot be given in detail.

NUMBER.	DISTANCES.		Lift in feet.
	Lock to Lock.	From Albany.	
1	....	....	15·159
2	98 chains 83 links	1·24 miles	9·495
3	419 chains 16 links	6·48 miles	11·169
4	25 chains 17 links	6·80 miles	11·380
5	21 chains 90 links	7·07 miles	10·597
6	16 chains 52 links	7·28 miles	10·073
7	10 chains 61 links	7·41 miles	9·931
8	12 chains 86 links	7·57 miles	10·545
9	26 chains 53 links	7·90 miles	9·408

TABLE — (*Continued*).

NUMBER.	DISTANCES.		Lift in feet.
	Lock to Lock.	From Albany.	
10	14 chains 58 links	8·08 miles	10·362
11	12 chains 91 links	8·24 miles	9·621
12	11 chains 66 links	8·39 miles	9·986
13	16 chains 5 links	8·59 miles	10·345
14	17 chains 9 links	8·80 miles	10·032
15	21 chains 53 links	9·07 miles	9·833
16	15 chains 20 links	9·26 miles	10·045
17	25 chains 39 links	9·58 miles	10·287
18	15 chains 44 links	9·77 miles	10·249
19	708 chains 42 links	18·63 miles	8·441
20	219 chains 29 links	21·37 miles	10·418
21	257 chains 90 links	24·59 miles	11·126
22	14 chains 1 link	24·77 miles	11·609
23	553 chains 43 links	31·69 miles	8·318
24	63 chains 7 links	32·47 miles	7·326
25	303 chains 87 links	36·27 miles	8·581
26	510 chains 59 links	42·66 miles	8·365
27	16 chains 8 links	42·86 miles	7·886
28	417 chains 16 links	48·07 miles	7·723
29	157 chains 20 links	50·04 miles	7·399
30	50 chains 60 links	50·67 miles	10·213
31	1108 chains 34 links	64·52 miles	5·867
32	505 chains 62 links	70·84 miles	8·126
33	408 chains 77 links	75·95 miles	5·704
34	205 chains 63 links	78·52 miles	8·483
35	254 chains 23 links	81·70 miles	7·785
36	349 chains 20 links	86·07 miles	10·019
37	49 chains 52 links	86·68 miles	9·898
38	12 chains 87 links	86·85 miles	8·733
39	17 chains 35 links	87·06 miles	10·524
40	220 chains 82 links	89·82 miles	8·524
41	211 chains 11 links	92·46 miles	8·286
42	228 chains 99 links	95·32 miles	7·954
43	20 chains 59 links	95·58 miles	8·069
44	216 chains 16 links	98·28 miles	10·737
45	98 chains 62 links	99·52 miles	11·172
45 to county line	537 chains 67 links	106·24 miles	....

ERIE CANAL — AQUEDUCTS.

There are sixteen aqueducts on this division of the Erie canal, the abutments and piers of which are all dressed masonry.

No. 1, known as the lower Mohawk aqueduct, is located at Crescent, three and a half miles north of Cohoes, where the canal crosses the Mohawk river; it is 1,137 feet long, has twenty-six arches supported by two abutments, and twenty-five stone piers; this is the largest aqueduct on the canals. The masonry is in good condition. Slight repairs should be made to the timber work.

No. 2 is known as the upper Mohawk aqueduct, located at Rexford Flats, four miles east of Schenectady, crossing the Mohawk river at that point. It is 610 feet long and has thirteen arches. The masonry in this structure is in good condition. The ice breakers should be protected by timber and plank. Some of the timber work is decayed and needs to be renewed, especially in the foot bridge.

No. 3 is over Flat Stone creek, five and three-quarter miles west of Schenectady, and known as Van Slykes' aqueduct, is seventy-two feet long with three arches. The creek channel above and below the structures should be cleared.

No. 4, over Sansai Kill at Pattersonville, Schenectady county, is known as Hoffman's aqueduct, and is 102 feet long and has four arches. Some of the masonry at the ends of the piers and abutments on the berme side which has been displaced during the spring freshets by ice, should be replaced, and portions of the wings need repointing. The creek channel above and below the aqueduct and under the trunk is very badly filled up and has to be cleaned out every year.

No. 5, known as the Schoharie creek aqueduct is located at Fort Hunter, Montgomery county, and crosses Schoharie creek. This structure is 624 feet long and has fourteen arches. Two of the piers need rip rap or crib work around them to prevent scouring and settling. The trunk has been repaired.

No. 6, over Tokkon creek, three and a half miles west of Fultonville, Montgomery county, is known as Van Wies aqueduct. It is 101 feet long, is constructed with abutments and piers, has no arches, but four openings; is in good condition. The trunk has been renewed and masonry repaired and pointed.

No. 7, over Leonardsson creek at Yatesville, Montgomery county, known as the Yatesville aqueduct. It is 101 feet long and is the same kind of structure as No. 6. This structure is in good condition. The masonry has been repaired and pointed. The creek channel should be cleaned.

No. 8, over Leonardsson creek at Little Nose, known as Lasher's aqueduct. It is seventy-four feet long, is constructed of abutments and piers without arches and only three spans. The masonry has been repaired and repointed to the water level, and new caps put on. The creek channel needs clearing.

No. 9 is over Platt Kill at Spraker's basin, Montgomery county, known as Spraker's aqueduct. It is 128 feet long and has five arches. Masonry and trunk in good condition. The creek is filled almost up to the bottom of the trunk and needs a large amount of work every year to keep a sufficient opening under it to allow a passage for the water. The entire trunk of this structure has to be removed during the close of navigation each year; to save it from being floated and destroyed.

No. 10 is over Bowman's creek at Canajoharie, Montgomery county, and is known as Canajoharie aqueduct. This structure was built in every way like the last described, having five arches, but owing to the violent character of the stream during the spring freshets several years since, three of the piers were so much injured, that it was thought best to remove the upper portion. Since that time wooden bents have been used for sustaining the trunk during the season of navigation, which have to be removed at the close of each year. The masonry and trunk are in good condition. More or less work has to be done here every season to keep the channel open.

No. 11, over Otsquago creek at Fort Plain, Montgomery county, and known as the Fort Plain aqueduct. It is 126 feet long and has five arches with the masonry and trunk in good condition. The trunk of this aqueduct also has to be removed during the close of navigation. The channel of the creek should be cleared.

No. 12, over Castle creek in Herkimer county, five miles east of Little Falls, known as Castle creek aqueduct, is 128 feet long and has five arches. The masonry and trunk need only slight repairs. The channel of the stream below the aqueduct ought to be cleared and grubbed, then graded to turn the water into the centre of the stream. Some years since spring freshets washed the channel on one side deeper than the other, and the stream has since been confined there, leaving the other side overgrown with trees, which are now of considerable size. The stream, while confined to this side of the channel, is injuring the covering of the feeder culvert a short distance below where the feeder passes under the stream, and should therefore be turned to the centre of the channel. The docking in the creek is in bad condition, and instead of removing the same, I would recommend that the stone removed from the channel be used to rip rap the bank or pave the same.

No. 13, over Fulmer's creek at Mohawk, Herkimer county, is known as the Mohawk aqueduct. This structure is seventy-four feet long with three arches. The upper portion of the west pier on the berme side has masonry displaced which should be relaid, and the joints of the masonry should be pointed. The channel should be cleared.

No. 14, over Steel's creek at Ilion, Herkimer county, known as the Ilion aqueduct, is only fifty feet long and has two arches. Some of the masonry on the upper portion of the pier on the berme side is displaced and should be relaid, and the entire coping of the parapet wall on the outside of tow-path has been removed. The berme wings have large leaks which will probably require much more work than to point them only; possibly some portion of the masonry in one wing will have to be taken up. All the masonry needs thorough pointing and the channel of the stream should be cleared.

No. 15, over Myer's creek at Frankfort, Herkimer county, known as the Frankfort aqueduct. This aqueduct is a duplicate of No. 14, and is in about the same condition. The masonry needs some attention, replacing small portions and a large amount of pointing. One side of the trunk should be new and the channel of the creek should be cleared.

No 16, over Ferguson's creek in Herkimer county, three miles east of Utica, and known as Ferguson's aqueduct, is twenty-two feet long and but one arch. The masonry is in good condition, but needs repointing.

AQUEDUCTS — Erie Canal.

Number.	NAME.	Location, Distance west of lock	Interior width.	Number of spans.	Total length.
1	Lower Mohawk	220 chains 52 links west of lock 18	40 ft 6 in	....	17 chains 23 links
2	Upper Mohawk	6 “ 60 “ “ “ 22	44 ft 4 in	....	9 “ 25 “
3	Flat Stone Creek	113 “ 97 “ “ “ 24	....	3	1 “ 13 “
4	Sansai Kill	171 “ 9 “ “ “ 25	52 ft	4	1 “ 55 “
5	Schoharie Creek	8 “ 97 “ “ “ 30	40½ ft	14	9 “ 46 “
6	Tokkon Creek	664 “ 91 “ “ “ 30	51⅓ ft	4	1 “ 53 “
7	Leonardson Creek	846 “ 38 “ “ “ 30	51 ft	4	1 “ 53 “
8	Leonardson Creek	934 “ 92 “ “ “ 30	50 ft	3	1 “ 13 “
9	Platt Kill	5 “ 77 “ “ “ 31	50 ft	5	1 “ 94 “
10	Bowman’s Creek	251 “ 97 “ “ “ 31	....	5	1 “ 94 “
11	Otsquago Creek	18 “ 31 “ “ “ 32	....	5	1 “ 91 “
12	Castle Creek	7 “ 1 “ “ “ 35	50½ ft	5	1 “ 94 “
13	Fulmer’s Creek	2 “ 72 “ “ “ 43	65½ ft	3	1 “ 12 “
14	Ilion Aqueduct	129 “ 36 “ “ “ 43	51½ ft	2	74 “
15	Myers’ Creek	2 “ 74 “ “ “ 45	66 ft	2	74 “
16	Ferguson’s Creek	452 “ 35 “ “ “ 45	57½ ft	1	33 “

ERIE CANAL — WASTE WEIRS AND SPILLWAYS.

No. 1. Spillway and waste-weir at West Troy on berme side of canal at upper end of the arsenal grounds, cut stone structure with bulkhead and gates, 33 foot spillway, less ten posts of one foot each and in fair condition.

No. 2. Spillway and waste-weir at West Troy, out of the Mohawk bason into the Hudson river, cut stone with bulkhead and gates in fair condition.

No. 3. Spillway and waste-weir a short distance below lock No. 4, in tow-path, cut stone with breast wall of masonry; spillway fifteen feet, is in fair condition. Masonry should be pointed.

No. 4. Spillway and waste-weir six and one-half chains west of lock No. 9 in tow-path, cut stone with breast wall; spillway fourteen feet six inches. Masonry in lower wing displaced and needs pointing.

No. 5. Spillway and waste-weir, a short distance above lock No. 18 in tow-path, cut stone with timber bulk-head, has twelve wickets; spillway, twenty-eight and one-half feet. This structure needs a new bulkhead and gates; as it now is, cannot be used.

No. 6. Spillway and waste-weir about 400 feet above lock No. 20 in tow-path, is of cut stone, arch eight foot chord and seventeen feet spillway. The masonry is in very bad condition and should be rebuilt from foundation.

No. 7. Waste-weir and spillway, just west of Frog alley bridge at Schenectady in tow-path. This is an old cut stone structure with spillway about 120 feet long which has been abandoned, but the bulkhead portion is still in use with spillway of twelve feet. This structure should be rebuilt with a much shorter spillway, say of thirty feet.

No. 8, waste-weir and spillway, about a quarter of a mile east of Port Jackson in tow-path. This is a nearly new structure of wood and stone; bulkhead should be rebuilt, spillway twelve feet, in good condition.

No. 9. Waste-weir with bulkhead in the tow-path about 500 feet east of lock No. 31, is a wooden structure and considerably decayed. Most of the timbers and plank will need to be new, also bulkhead and gates.

No. 10. Waste-weir with bulkhead in the tow-path, about 100 feet west of lock No. 33.

No. 11. Wooden waste-weir, twenty-eight feet spillway on tow-path about one-fourth mile west of lock 33, built in 1883.

No. 12. Waste-weir and spillway, with culvert of four foot chord of cut stone, spillway thirteen and one-half feet, at Fink's basin, two miles east of Little Falls in tow-path; the wings at ends need some repairing by taking down a portion of the masonry and relaying, besides some general repairs.

No. 13 is located two and one-half chains west of lock 36; spillway eleven and one-half feet, two valves five and one-half by two and one-half.

No. 14. Waste-weir and spill-way, about a quarter of a mile west of Little Falls, in the tow-path. This is an old structure of cut stone arch, twelve feet chord with sixty feet spillway. Masonry is considerably displaced; that portion back of the tow-path should be rebuilt.

No. 15. Waste-weir and spillway just above lock No. 40, in tow-path, cut stone arch, twelve foot chord, spillway twelve feet. Back portion of this structure needs repairing, also needs new bulkhead.

No. 16. Spillway of seventy-five feet located ten and one-half chains west of Lock No. 41 ; has four valves 2½ ft. by 2 ft. 2 in.

No. 17 is eighteen chains west of lock 42. Fillled up and not used.

No. 18. Waste weir and spillway is about 500 feet west of lock No. 44 on berme side, cut stone ; about seventy feet of spillway has been raised with two courses of timber, and should be raised with stone. A new bulkhead is needed and some other general repairs of masonry.

The receivers, one above lock No. 20, one below lock No. 23, one east of Ilion and one west of lock No. 45, all on the berme side of the canal are in good condition.

The foundation and masonry of the two lower over-falls at Meyer's creek, Frankfort, have settled and need repairs.

WASTE-WEIRS — Erie canal.

Number.	LOCATION, DISTANCE WEST OF LOCK.	Number of valves.	Size of valves.	Length of spillway.	Height of crest + C. B.
1	308 chains, 30 links west lock 2	4	2½ ft.x3 ft	33 feet less 10 posts, 1 foot each	6.83
2	At West Troy	..			
3	19½ chains west lock 3	10	2 ft.x2½ ft	15 ft	7.58
4	7½ chains west lock 9	5	2 ft. 1 in.x2 ft. 8 in.	14 ft. 6 in.	7.59
5	18 chains, 40 links west lock 18	8		28 ft. 6 in.	6.36
6	12 chains, 20 links west lock 20	4	2 ft.x2½ ft	17 ft	5.91
7	368 chains, 46 links west lock 22	4	2 ft.x2½ ft	12 ft	6.80
8	163 chains, 84 links west lock 27	3	4 ft. 3 in.x2 ft. 10 in.	12 ft	7.41
9	1,097 chains, 9 links west lock 30	4	3 ft.x2½ ft	12 ft	7.48
10	3 chains, 56 links west lock 33	2	5 ft.x2½ ft	10 ft	Bot. of opening, 4.5+C. B.
11	One-fourth mile west lock 33	..		28 ft	
12	286 chains, 2 links west lock 35	5	2 ft.x2½ ft	13 ft. 6 in.	7.58
13	2 chains, 50 links west lock 36	2	5½ ft.x2½ ft	11 ft. 6 in.	Bot. of opening, 4.92+C. B.
14	16 chains, 52 links west lock 39	4		60 ft	6.73
15	13 chains, 2 links west lock 40	..		12 ft	
16	10 chains, 64 links west lock 41	4	2½ ft.x2 ft. 2 in.	75 ft	7.42
17	18 chains, 32 links west lock 42	..			Filled up; not in use.
18	About 8 chains west lock 44	..		70 ft	

ERIE CANAL.

Culverts.

There are one hundred and twenty-seven culverts on this division of the Erie canal, ninety-nine of which are for the canal proper, three for Rocky Rift feeder and twenty-five under various bridge approaches. Eighty-seven of those under the canal are located as shown in the table below.

TABLE.

Culverts, Eastern Division Erie Canal.

Number 1, 31 chains west of lock 1, stone diving culvert, 3 openings.
Number 2, 60 chains, 75 links west of lock 1, stone arch culvert, 4 feet chord.
Number 3, 39 chains, west of lock 2, stone arch culvert.
Number 4, 97 chains, 28 links west of lock 2, stone arch culvert.
Number 5, 138 1-2 chains, west of lock 2, stone arch culvert.
Number 6, 167 chains west of lock 2, stone arch culvert.
Number 7, 189 chains, 40 links west of lock 2, stone double arch culvert, 7 feet chord.
Number 8, 276 chains, 45 links west of lock 2, stone double arch culvert.
Number 9, 313 chains, 25 links west of lock 2, stone double arch culvert, about 8 feet chord.
Number 10, under Ferry street bridge approach, arch culvert, 12 feet chord.
Number 11, 398 chains, 30 links west of lock 2, stone diving culvert.
Number 12, 16 chains west of lock 3, stone diving culvert.
Number 13, between locks 6 and 7, semi-circle arch, 12 feet chord, 7 feet bench wall.
Number 14, 9 1-2 chains, west of lock 9, semi-circle arch, 8 feet chord, 2 feet 3 inch bench wall.
Number 15, 9 chains, west of lock 13, semi-circle arch, 7 1-2 feet chord, 2 feet bench wall.
Number 16, 1 chain, west of lock 17, stone arch culvert, 4 feet chord.
Number 17, 28 chains, 65 links west of lock 18, semi-circle arch, 8 feet chord, 3 feet bench wall.
Number 18, 187 1-2 chains, west of lock 18, stone diving culvert.
Number 19, 250 chains, 54 links west of lock 18, semi-circle arch, 8 feet chord, 5 1-2 feet bench wall.
Number 20, 483 chains, 55 links west of lock 18, stone arch culvert, 6 feet chord.
Number 21, 515 chains, 54 links west of lock 18, box wooden trunk diving, 3 openings 3′ x 2′ each.
Number 22, 651 chains, 95 links west of lock 18, stone box diving, 3 feet wide, 2 feet high.
Number 23, 65 chains, 90 links west of lock 19, stone semi-circle arch, 9 feet chord, 5 1-2 feet bench.
Number 24, 157 chains, 12 links west of lock 20, stone diving.
Number 25, 5 chains, 60 links west of lock 22, stone arch, 13 feet chord.
Number 26, 203 chains, 86 links west of lock 22, stone arch, 7 1-2 feet chord, 2 feet rise, 4 feet bench wall.

Number 27, 277 chains, west of lock 22, stone arch diving, 13 feet chord, 2 1-2 feet rise.

Number 28, 299 chains, 70 links west of lock 22, stone culvert, 6 feet chord.

Number 29, 349 chains, 95 links west of lock 22, stone arch, about 8 feet chord.

Number 30, 412 chains, 25 links west of lock 22, stone arch, about 7 feet chord.

Number 31, 464 chains, 50 links west of lock 22, stone semi-circle arch, 12 feet chord, 2 1-2 feet bench wall.

Number 32, 12 chains west of lock 24, stone arch, 7 feet chord.

Number 33, 149 chains, 40 links west of lock 24, stone arch, 7 feet chord, 2 1-2 feet bench wall.

Number 34, 174 chains, 12 links west of lock 24, stone semi-circle arch, 11 feet chord.

Number 35, 154 chains, 60 links west of lock 25, stone box, 2 1-2 feet wide, 2 feet 10 inches high.

Number 36, 218 chains, 8 links west of lock 25, stone semi-circle arch drop, 4 feet chord 1 foot 6 inches bench walls.

Number 37, 269 chains, 90 links west of lock 25, wooden box culvert, 2 feet 4 inches by 1 foot 4 inches.

Number 38, 360 chains, 70 links west of lock 25, stone semi-circle arch, 4 feet chord.

Number 39, 401 chains, 20 links west of lock 25, stone arch drop, 10 feet chord, 2 1-2 feet rise.

Number 40, 3 chains, 13 links west of lock 27, stone drop double, 18 feet chord, 3 feet rise, 2 1-2 feet bench wall.

Number 41, 61 chains, 45 links west of lock 27, stone arch, 7 feet chord, 4 1-2 feet bench walls.

Number 42, 96 chains, 40 links west of lock 27, stone arch drop double, 4 feet chord, 2 feet bench walls.

Number 43, 163 chains, 84 links west of lock 27, stone arch drop culvert, 6 feet chord, 2 1-2 feet bench walls.

Number 44, 207 chains west of lock 27, stone culvert.

Number 45, 255 chains, 17 links west of lock 27, stone arch, four arches, 22 feet chord, 4 feet rise, 3 feet bench walls.

Number 46, 5 chains, 24 links west of lock 28, stone arch drop, 6 feet 2 inches chord, 3 feet 2 inches high.

Number 47, 85 chains, 20 links west of lock 28, stone arch culvert, 4 feet chord, 1 foot bench walls.

Number 48, 140 chains west of lock 28, small stone diving culvert.

Number 49, 71 chains, 50 links west of lock 30, stone arch culvert, 4 feet chord, 2 feet high.

Number 50, 146 chains, 20 links west of lock 30, stone double arch, 10 feet chord, 3 1-2 feet rise, 2 feet bench wall.

Number 51, 170 chains, 50 links west of lock 30, stone arch (4 arches), 22 1-3 feet span, 4 feet rise, 4 1-2 feet bench wall.

Number 52, 282 chains, 50 links west of lock 30, stone box diving, 3 feet wide.

Number 53, 336 chains west of lock 30, stone arch drop, 4 feet chord.

Number 54, 400 chains, 25 links west of lock 30, stone arch drop double, 2 feet chord, about.

Number 55, 427 chains, 10 links west of lock 30, stone arch drop, 4 feet chord, about 2 feet rise.

Number 56, 707 chains, 40 links west of lock 30, stone semi-circle arch, 4 feet chord, 1 1-2 feet bench wall.

Number 57, 807, chains, 60 links west of lock 30, stone semi-circle drop, 4 feet chord 1 1-2 feet bench wall.

Number 58, 1,096 chains, 55 links west of lock 30, stone box drop, 5 feet wide.

Number 59, 32 chains, 65 links west of lock 31, stone arch drop, about 8 feet chord, 2 feet rise.

Number 60, 224 chains, 80 links west of lock 31, stone semi-circle arch, 4 feet chord.

Number 61, 294 chains, 36 links west of lock 31, stone drop.

Number 62, 377 chains, 70 links west of lock 31, stone drop box and arch, 17 ft chord, 6 ft. 3 in. rise.

Number 63, 78 chains west of lock 32, stone box, 2 ft. by 2 ft.

Number 64, 122 chains west of lock 32, stone arch, 12 ft. chord, 3 ft. rise.

Number 65, 140 chains west of lock 32, stone drop.

Number 66, 243 chains, 40 links west of lock 32, stone arch drop, 7 ft. chord, 2½ ft. rise.

Number 67, 314 chains, 84 links west of lock 32, stone arch culvert.

Number 68, 29 chains, 20 links west of lock 33, stone semi-circular arch diving, 6 ft. chord, 1 ft. bench walls.

Number 69, 172 chains, 35 links west of lock 33, stone wooden box, 4 ft. high, 2 ft. wide.

Number 70, 210 chains west of lock 34, diving, about 8 ft. chord.

Number 71, 92 chains west of lock 35, stone.

Number 72, 222 chains, 36 links west of lock 35, stone diving culvert.

Number 73, 158 chains, 8 links west of lock 39, stone diving culvert.

Number 74, 199 chains, 94 links west of lock 39, stone diving culvert.

Number 75, 8 chains west of lock 40, stone arch, about 4 ft. chord.

Number 76, 107 chains, 80 links west of lock 40, stone diving culvert.

Number 77, 147 chains, 20 links west of lock 40, stone diving culvert.

Number 78, 7 chains, 12 links west of lock 41, stone arch drop (double arch), 6 ft. chord, 1½ ft. rise, 2½ ft bench wall.

Number 79, 26 chains, 75 links west of lock 43, stone box culvert, 4½ ft. wide, 2 openings.

Number 80, 77 chains, 50 links west of lock 43, stone semi-circular arch, 3 ft. chord, 1 ft. bench walls.

Number 81, 191 chains, 10 links west of lock 43, stone semi-circular arch, 7 ft. chord, 2 ft. bench walls.

Number 82, 207 chains, 57 links west of lock 43, stone semi-circular arch, 3 ft. chord, 2 ft. 9 in. bench walls.

Number 83, 118 chains, 65 links west of lock 45, stone arch, 12 ft. chord, 3 ft. rise, 8 ft. bench walls.

Number 84, 285 chains, 70 links west of lock 45, stone box, 2 ft. by 2 ft.

Number 85, 370 chains, west of lock 45, stone box, 2½ ft. wide by 2 ft. high.

Number 86, 397 chains, 30 links west of lock 45, stone box, 2½ ft. wide, 2 ft. high.

Number 87, 468 chains, 60 links west of lock 45, stone semi-circle arch, 4 ft. chord, 1½ ft. bench walls.

In addition to the above there are as follows:

One about two miles west of Fort Plain, constructed by the New York, West Shore and Buffalo Railway Co.: it consists of dressed masonry and extends only through the tow-path to drain the bottom of canal level.

One east of Schenectady, between the D. & H. C. Co.'s railroad bridge and Highway bridge No. 55, is a cut stone arch, six foot chord; one about 100 feet east of arch culvert No. 39; two at Yankee hill, respectively one and two miles west of Port Jackson, between culverts 45 and 46; the fifth is about a half mile west of St. Johnsville, between culverts 68 and 69. The four last mentioned are wooden box, about 2 ft. by 2 ft. under the tow-path to the centre of the canal for draining the levels. The sixth at Fink's basin, two miles east of Little Falls, under the waste-weir, cut stone arch, four foot chord; the seventh at the foot of lock 38 at Little Falls, for the feeder is cut stone arch twelve foot chord; the eighth and ninth about three-quarters, and one and one-quarter miles, respectively, east of Mohawk, are wooden box 2 ft. by 2 ft., like those at Yankee hill; tenth at Ilion, between culverts 80 and 81, stone box 2 ft. by 2 ft., and the eleventh is located one-fourth mile east of Frankfort, between culverts 82 and 83, is of cut stone, diving, box 2 ft. by 2 ft. For the Rocky Rift feeder, five miles east of Little Falls under Castle creek, is a large stone box culvert with six openings, each 6 ft. by 3 ft.; also two culverts of stone under Rocky Rift feeder.

'One at West Troy under tow-path approach of bridge No. 16, stone arch, ten foot chord, and twenty-four others under various bridge approaches, principally stone box of different sizes. No extensive repairs have been made to any of the culvert structures, during the year. A few have had some inexpensive ordinary repairs. Although considerable work has been done in cleaning out the culverts, it was barely enough to keep them open, and only in a very few cases have the culverts been thoroughly cleaned of all the material deposited in them or in the channels from them.

RECOMMENDATIONS.

No. 10, between locks 3 and 4. The south side of the lower wing is badly undermined by the slate rock being washed away, and needs a protection wall under and in front of it; also new planking through the arch, and the masonry should be pointed.

No. 21, at Clutes dry dock. Box with three openings, each 3 ft. by 2 ft., wooden trunk, stone ends. The masonry is in bad condition, tow-path end has settled. The berme end, which was rebuilt but a short time ago, was completely undermined by a break which occurred directly over the structure in August of this year, and will have to be rebuilt. I would recommend that the entire structure be rebuilt of stone. The old wooden trunk culverts are becoming unsafe and should be replaced with stone.

No. 22, on level between locks 18 and 19; small box culvert; masonry-dressed stone. Parapet and wings on tow-path end are badly broken and displaced, and must be relaid soon. A ditch several hundred feet long is badly filled up and should be cleared.

No. 25, located on level between locks 22 and 23 at East Schenectady, dressed stone arch, 13 ft. chord. Part of the wing masonry should be relaid and the structure pointed.

No. 27, located on same level at Schenectady, dressed stone arch. Masonry needs some pointing and more or less excavation in channel.

No. 28, on the same level, one-half mile west of Schenectady, dressed stone arch. The masonry is falling to pieces at the tow-path end of structure, and must be relaid soon; also the ditch should be cleaned.

No. 29, is on the same level, one and one-half miles west of Schenectady, dressed stone. Masonry needs pointing and new planking on bottom of arch, also concrete between foundation timbers and some excavation in creek channel.

No. 37 is located 270 chains west of lock 25. Wooden box through the tow-path is in a very bad condition and should be removed and replaced by bank. There is no necessity for a structure in this place.

No. 40, located on level between locks 27 and 28, dressed stone, double arch, eighteen foot chord. Some new coping and considerable pointing needed, structure and stream filled to within, say an average of two feet of top of arch.

No. 41, on the same level, dressed stone arch, 7 ft. chord. Masonry needs pointing, also a new course of plank over the foundation timbers on the arch and the channel should be excavated.

No. 43, located on same level, dressed stone arch, 6 ft. chord. This culvert has a waste-weir over it. The tow-path wings are crowded over and breaking, and should be repaired.

No. 44, on same level. Vertical wall parapet on tow-path end overhangs masonry. This structure needs cleaning and examining, and channel cleared.

No. 45, situated on same level, about one-fourth of a mile west of Port Jackson, dressed stone masonry, arch, 4′ rise, 22 ft. chord. Masonry needs pointing generally, and a large amount of excavating will have to be done to clear the channel.

Not numbered. There are two box culverts through the towing-path at Yankee hill, both of which are old and need repairs.

No. 48, located on level between locks 28 and 29. Some masonry and coping should be relaid and the structure should be pointed, and stream channel cleared.

No. 49, located on level between locks 30 and 31, dressed stone arch, 4 ft. chord; some pointing to be done and new plank needed inside the arch, a portion of the ditch to be opened.

No. 60, located on level between locks 31 and 32, dressed stone arch, 4 ft. chord. Masonry and coping to be relaid and some pointing. Channel to be cleared.

No. 66, located on level between locks 32 and 33, dressed stone arch, 7 ft. chord. The tow-path end is being crowded over. Some masonry should be relaid on the berme side, and the channel should be cleared.

No. 69, located on level between locks 33 and 34, is an old wooden trunk through the tow-path and considered unsafe. A new one is needed.

No. 70, located on level between locks 34 and 35, dressed stone box culvert. The tow-path end is entirely out of sight and is covered with water and earth. Berme end of masonry is badly broken and displaced. Channel should be cleared.

No. 73, located on level between locks 39 and 40, dressed stone box, 14 ft. parapet wall. Masonry at tow-path end is badly broken and displaced. The berme end should be pointed and the channel cleared.

No. 76 is on the same level, dressed stone box, 8 ft. parapet wall. Tow-path end masonry is badly displaced and should be relaid.

No. 77, located on same level is the same kind of structure and in the same condition.

No. 78, located on level between locks 41 and 42, dressed stone double arch, six foot chord. Some masonry to be relaid on berme end and new planking needed.

No. 80, located on level between locks 43 and 44, dressed stone arch, 3 ft. chord. Masonry to be relaid on tow-path end and the rest pointed; also the ditch to be opened.

No. 89, located on level between lock 45 and west end of this division, dressed stone box culvert. Tow-path end has masonry broken up and displaced, which should be relaid.

No. 90, located on level between lock 45 and west end of this division, dressed stone arch, 6 ft. chord. Masonry on tow-path is broken up and displaced and needs relaying. Berme end has no parapet or wings. About forty feet of this end of the arch is of small poor stone, some of which have fallen out of the inside of the arch, rendering it unsafe and it should be rebuilt.

Many culverts under bridge approaches need more or less repairs.

Rocky Rift Feeder culvert under Castle creek, consists of six openings, each 6 ft.x3 ft. The paving protection over the covering stone has been entirely washed away, and some of the covering has been displaced, causing more or less leakage from the feeder into the creek, besides endangering the safety of the structure; the covering should be relaid, new paving laid secured by anchor timbers and plank, also portions of the wing walls above and below the structure relaid, and the masonry should be pointed, with other slight repairs.

Many culverts need thorough pointing, as very little mortar remains in the joints, which are partially filled with roots, weeds and grass. This, together with some leaking, leaves the masonry in a condition to be seriously injured by frost from year to year. Much of the above masonry mentioned as being broken and displaced has been rendered so by the action of the frost, through neglect in pointing the same.

The channels and ditches above and below many of these structures need more or less cleaning.

ERIE CANAL BRIDGES.

The following table gives a list and location of the most important bridges on the eastern division of the Erie canal, classified as follows: Forty-two road, thirty-four street, ninety-eight farm, five change, one foot, five tow-path and eight railroad bridges.

Between Locks 1 and 2.

Number.	NAME.	Location.	Plan.	Material.	Span.	
					ft.	in.
1....	Road........	Sta. O + to O +........	Whipple cast iron arch....................	Iron.....	48	
2....	Street........	Sta. 11.31 to 11.85.......	Wrought iron swing......................	Iron.....	......	
3....	Road.......	Sta. 16 + 45 to 17........	Whipple trapezoidal truss..................	Iron.....	113	
4....	Road........	Sta. 53 48 to 53 + 75...	Wrought iron arch truss....................	Iron.....	......	
5....	Foot.........	Sta. 82.90 to	Suspension foot bridge.....................	Wood.....	98	
Between Locks 2 and 3.						
6....	Farm.........	Sta. 47 + 53 to 47+80.	Wooden Whipple truss....................	Wood....	72	[illegible]
7....	Road........	Sta. 114. to 114 28.	Wooden Whipple truss....................	Wood....	71	6
8....	Road........	Sta. 134 43 to 134 82.	Whipple cast iron arch....................	Iron......	78	4
9....	Road.......	Sta. 157. to 157 42.	Whipple wooden truss....................	Wood....	82	
10....	Road........	Sta. 186. to 186 42.	Whipple wooden truss....................	Wood....	83	3
11....	Street.........	Sta. 215 28 to 215 60.	Whipple wooden truss....................	Wood....	81	6
12....	Street........	Sta. 243 35 to 243 72.	Whipple wooden truss....................	Wood ...	76	
13....	Street.........	Sta. 260 80 to 261 14.	Whipple wooden truss....................	Wood....	82	6
14....	Street.........	Sta. 268 70 to 269 34.	Wrought iron lattice.....................	Iron.....	......	
15....	Street........	Sta. 290 to	U. S. Arsenal bridge, wooden..............	Wood....	......	
16....	Street........	Sta. 302 to	U. S. Arsenal bridge, cast pipe arch........	....	......	
17....	Street........	Sta. 312 41 to 312 73.	Whipple cast iron arch....................	Iron.....	91	
18....	Street........	Sta. 320 40 to 321 46.	Whipple cast iron arch....................	Iron.....	81	
19....	Street........	Sta. 338 58 to 339 48.	Wrought iron arch truss....................	Iron.....	84	6

20....	Street........	Sta. 350 + 11 to 350 + 57.	Whipple cast iron arch....................	Iron.....	81	6
21....	Change......	Sta. 363 38	Wrought iron pipe arch....................	Iron.....	94	
22....	Street........	Sta. 365 47 to 365 90.	Cast iron pipe arch truss....................	Iron.....	80	6
23....	Street........	Sta. 379 74 to 380 24.	Whipple cast iron arch....................	Iron.....	81	6
24....	Road.........	Sta. 400 74 to 401 67.	Wrought iron Warren truss................	Iron.....	......	
25....	Change........	Sta. 415 12 to 415 78.	Whipple trapezoidal truss..................	Iron.....	120	
			Between Locks 3 *and* 4.			
26....	Railroad........	2 1-2 chains below lock 4.	Whipple trapezoidal truss..................	Iron.....	......	
			Between Locks 4 *and* 5.			
27....	Road.........	3 chains above lock 4.....	Town's wooden lattice truss................	Wood....	110	
			Between Locks 8 *and* 9.			
28....	Road.........	5 chains below lock 9.....	Whipple cast iron arch....................	Iron.....	109	9
			Between Locks 12 *and* 13.			
29....	Street........	Halfway between locks...	Whipple cast iron arch truss................	Iron.....	121	
			Between Locks 13 *and* 14.			
30....	Street........	8 chains above lock 13....	Whipple trapezoidal truss..................	Iron.....	110	
			Between Locks 15 *and* 16.			
31....	Street........	4 chains below lock 16....	Whipple trapezoidal truss..................	Iron.....	121	
			Between Locks 17 *and* 18.			
32....	Farm.........	4 chains below lock 18....	Whipple wooden truss.....................	Wood....	99	10

BRIDGES — (Continued.)

Between Locks 18 *and* 19.

Number.	NAME.	Location.	Plan.	Material.	Span.
33....	Change.......	Sta. 13 + 80 to 14 + 20.	Whipple cast iron arch truss...	Iron.....	80 6
34....	Farm.........	Sta. 57 8 to 57 36.	Whipple wooden truss....................	Wood....	72 4
35....	Farm.........	Sta. 128 11 to 128 45.	Whipple wooden truss....................	Wood....	72 6
36....	Farm.........	Sta. 168 96 to 169 20.	Whipple wooden truss....................	Wood....	70 6
37....	Change......	Sta. 217 88 to 218 28.	Whipple cast iron arch truss...............	Iron.....	72
38....	Road........	Sta. 244 15 to 244 45.	Whipple wooden truss....................	Wood....	86 4
39....	Farm.........	Sta. 340 21	Whipple wooden truss.	Wood....	72
40....	Farm.... ...	Sta. 369 to 369 28.	Whipple wooden truss....................	Wood....	71 9
41....	Farm........	Sta. 432 37 to 432 55.	Whipple wooden truss....................	Wood....	72
42....	Road........	Sta. 511 95 to 512 25.	Whipple wooden truss....................	Wood....	89.
43....	Farm........	Sta. 521 52 to 521 82.	Whipple wooden truss....................	Wood....	70. 4
44....	Farm........	Sta. 542 93 to 543 20.	Whipple wooden truss....................	Wood....	70 9
45....	Farm........	Sta. 567 94 to 568 24.	Whipple wooden truss................ ...	Wood ...	72
46....	Road........	Sta. 598 42 to 598 75.	Iron pin connection	Iron.....	70
47....	Farm........	Sta. 633 65 to 633 95.	Whipple wooden truss....................	Wood....	70 4
48....	Farm........	Sta. 642 12 to 642 42.	Whipple wooden truss....................	Wood....	69
49....	Farm........	Sta. 658 40 to 658 70.	Whipple wooden truss....................	Wood....	71 6
50....	Farm........	Sta. 693 41 to 693 73.	Whipple wooden truss....................	Wood....	73

Between Locks 19 *and* 20.

Number.	NAME.	Location.	Plan.	Material.	Span.
51....	Farm........	Sta. 56 to 56+20........	Whipple wooden truss.....	Wood....	71
52....	Road........	Sta. 69+55 to 69+85.....	Whipple wooden truss....................	Wood....	74

Between Locks 20 and 21.

53....	Road	Sta. 108 + 80 to 109 + 4..	Whipple wooden truss....................	Wood....	72	6
54....	Change	Sta. 250 32 to 250 52..	Whipple wooden truss....................	Wood....	87	6
55....	Tow-path	Sta. 255 to 255 60..	Whipple wooden truss....................	Wood....	42	3

Between Locks 21 and 22.

56....	Tow-path ...	Sta. 928 + to 9 + 64	Draw bridge	Wood....	......	
57....	Farm........	Sta. 12 + 12 to 12 + 36...	Whipple wooden truss....................	Wood....	93	4

Between Locks 22 and 23.

58....	Road	Sta. 24 + 34 to 24 + 60..	Wooden whipple truss....................	Wood....	72	6
59....	Farm........	Sta. 142 92 to 143 16..	Wooden whipple truss....................	Wood....	72	3
60....	Farm........	Sta. 161 68 to 161 92..	Wooden whipple truss....................	Wood....	71	6
61....	Road	Sta. 230 12 to 230 44..	Wooden whipple truss....................	Wood....	72	6
62 ..	Road	Sta. 264 88 to 265 12..	Wooden whipple truss....................	Wood....	79	3
63....	Street........	Sta. 284 23 to 284 65..	Whipple cast iron arch truss	Iron	72	6
64....	Street........	Sta. 304 78 to 305 26..	Whipple wooden truss....................	Wood....	81	
65....	Street........	Sta. 311 22 to 311 90..	Whipple cast iron arch truss	Iron	92	
66....	R. Road......	Sta. 318 to 320 20..	Wrought iron lattice	Iron.....	......	
67....	Street........	Sta. 323 15 to 324 80..	Whipple cast iron arch truss	Iron	90	
68....	Street........	Sta. 331 12 to 331 80..	Wrought iron arch.........................	Iron.....	......	
69....	Street........	Sta. 337 7 to 338 36..	Wrought iron trapezoidal truss.............	Iron. ...	73½	
70....	Street........	Sta. 354 6 to 354 42..	Whipple wooden truss....................	Wood...	72	
71....	Street........	Sta. 365 78 to 366 36..	Whipple wooden truss....................	Wood....	78	
72....	Farm........	Sta. 504 36 to 504 64..	Whipple wooden truss....................	Wood....	70	

Between Locks 23 and 24.

73....	Farm........	Sta. 8 + 87 to 9 + 14..	Wrought iron	Iron.....	......	

BRIDGES — (Continued).

Between Locks 24 and 25.

Number.	NAME.	Location.	Plan.	Material.	Span. ft.	Span. in.
74....	Road	Sta. 49+64 to 50+1	Wrought iron	Iron	......	
75....	Road	Sta. 99 18 to 99 58	Whipple wooden truss	Wood	81	9
76....	Farm	Sta. 126½	Wooden whipple truss (private)	Wood	82	6
77....	Road	Sta. 181+36 to 181+72	Whipple wooden truss	Wood	77	6
78....	Farm	Sta. 218 2 to 218 28	Whipple wooden truss	Wood	70	
79....	Farm	Sta. 294 33 to 294 61	Whipple wooden truss	Wood	71	9

Between Locks 25 and 26.

Number.	NAME.	Location.	Plan.	Material.	Span. ft.	Span. in.
80....	Farm	Sta. 9 + 25 to 9 + 50	Whipple wooden truss	Wood	71	
81....	Farm	Sta. 40 25 to 40 50	Whipple wooden truss	Wood	71	6
82....	Farm	Sta. 73 76 to 74 2	Whipple wooden truss	Wood	70	6
83....	Road	Sta. 117 40 to 117 76	Whipple wooden truss	Wood	79	6
84....	Road	Sta. 185 78 to 186	Whipple wooden truss	Wood	71	
85....	Farm	Sta. 365 3 to	Whipple wooden truss	Wood	89	
86....	Farm	Sta. 398 53 to 398 75	Whipple wooden truss	Wood	71	
87....	Farm	Sta. 460 to 460 20	Whipple wooden truss	Wood	75	

Between Locks 26 and 27.

Number.	NAME.	Location.	Plan.	Material.	Span. ft.	Span. in.
88....	Farm	Sta. 12 + 56 to 12+78	Whipple wooden truss	Wood	87	

Between Locks 27 and 28.

89...	Street........	Sta. 202+92 to 203+48..	Whipple cast-iron arch truss...............	Iron.....	72	6
90...	Street........	Sta. 211 8 to 211 56.	Whipple cast-iron arch truss...............	Iron.....	75	

Between Locks 28 and 29.

91...	Farm........	Sta. 85+70 to 85+94. ..	Whipple wooden truss (private).............	Wood....	89	6
92...	Farm........	Sta. 138 to 138 22...	Whipple wooden truss.......................	Wood....	70	6

Between Locks 29 and 30.

93...	Farm........	Sta. 30 + to 30 + 22....				
94...	Road	Sta. 49 60 to 50 2.....	Whipple cast-iron arch truss...............	Iron.....	98	3

Between Locks 30 and 31.

95...	Farm........	Sta. 51½+ to 52+....	Wooden whipple truss......................	Wood....	71	6
96...	Farm........	Sta. 123 33 to 123 55..	Wooden whipple truss......................	Wood....	83	6
97...	Farm........	Sta. 152 28 to 152 50..	Wooden whipple truss......................	Wood....	83	9
98...	Farm........	Sta. 181 8 to 181 32..	Wooden whipple truss......................	Wood....	71	
99...	Farm........	Sta. 219 72 to 219 96..	Wooden whipple truss......................	Wood....	86	6
100...	Farm........	Sta. 253 36 to 253 60..	Wooden whipple truss......................	Wood....	69½	
101...	Road	Sta. 280 50 to 280 92..	Queen post truss...........................	Iron.....	95	
102...	Farm........	Sta. 306 6 to 306 28..	Whipple wooden truss......................	Wood....	70	
103...	Farm........	Sta. 344 96 to 345 28..	Whipple wooden truss......................	Wood....	68½	
104...	Road	Sta. 393 52 to 393 88..	Wooden whipple truss......................	Wood....	70	6
105...	Tow-path	Sta. 397 92 to 398 29..	Wooden whipple truss......................	Wood....	63	
106...	Street........	Sta. 412 4 to 412	Whipple cast-iron arch.....................	Iron	72	9
107...	Street........	Sta. 420 96 to 421 18..	Whipple cast-iron arch truss...............	Iron.....	75	6
108...	Farm........	Sta. 482 64 to 482 90..	Whipple wooden truss......................	Wood....	72	
109...	Farm........	Sta. 538 90 to 539 16..	Whipple wooden truss......................	Wood....	73	9
110...	Farm........	Sta. 612 50 to 612 75..	Whipple wooden truss......................	Wood....	71	

BRIDGES — (Continued).

Number.	NAME.	Location.	Plan.	Material.	Span. Ft.	Span. In.
111...	Farm........	Sta. 736 + 82 to 737 + 18.	Whipple wooden truss....................	Wood....	71	
112...	Farm........	Sta. 813 50 to 813 75.	Whipple wooden truss....................	Wood....	71	
113...	Farm........	Sta. 828 to 828 25.	Whipple wooden truss....................	Wood....	71	
114...	Farm........	Sta. 928 50 to 928 75.	Whipple wooden truss....................	Wood....	70	
115...	Farm........	Sta. 941 2 to 941 27.	Whipple wooden truss....................	Wood....	76	
116...	Farm........	Sta. 1079 8 to 1079 33.	Whipple wooden truss....................	Wood....	70	6
			Between Locks 31 *and* 32.			
117...	Farm........	Sta. 4 + 98 to 5 + 20..	Whipple wooden truss....................	Wood....	63	6
118...	Road........	Sta. 17 46 to 17 82..	Whipple cast-iron arch truss..............	Iron.....	70	
119...	Farm........	Sta. 49 to 49 28.	Whipple wooden truss....................	Wood....	71	9
120...	Farm........	Sta. 82 64 to 82 92..	Whipple wooden truss....................	Wood....	70	6
121...	Farm........	Sta. 142 33 to 142 55..	Whipple wooden truss....................	Wood....	70	6
122...	Farm........	Sta. 205 66 to 205 88..	Whipple wooden truss....................	Wood....	71	6
123...	Farm........	Sta. 241 76 to 241 98..	Whipple wooden truss....................	Wood....	69	9
124...	Street........	Sta. 259 66 to 260 17..	Whipple cast-iron arch truss..............	Iron.....	81	
125...	Farm........	Sta. 314 15 to 314 37..	Whipple wooden truss....................	Wood....	72	
126...	Farm........	Sta. 370 34 to 370 58..	Whipple wooden truss....................	Wood....	70	
127...	Farm........	Sta. 475 40 to 475 68..	Whipple wooden truss....................	Wood....	69	9
			Between Locks 32 *and* 33.			
128...	Farm........	Sta. 10 82 to 11 8...	Whipple wooden truss....................	Wood....	71	
129...	Street........	Sta. 27 98 to 28 43...	Cast-iron pipe arch truss..................	Iron.....	71	9

130...	Farm........	Sta. 59+52 to 59+76..	Whipple wooden truss....................	Wood....	72	
131...	Farm........	Sta. 89 88 to 90 9..	Whipple wooden truss....................	Wood....	70	6
132...	Farm........	Sta. 242 65 to....	Whipple wooden truss (private)............	Wood....		
133...	Farm........	Sta. 337 16 to 337 40..	Whipple wooden truss....................	Wood....	72	

Between Locks 33 *and* 34.

134...	Farm........	Sta. 23+66 to 23+92.	Whipple wooden truss....................	Wood....	71	10
135...	Road........	Sta. 65 90 to 66 15.	Whipple wooden truss....................	Wood....	81	9
136...	Farm........	Sta. 175 70 to 175 95.	Whipple wooden truss....................	Wood....	71	
137...	Farm........	Sta. 195 97 to 196 22.	Whipple wooden truss....................	Wood....	71	6
138...	Tow-path....	Sta. 199 70 to 200 10.	Over Rocky Rift feeder....................	Wood....	26	

Between Locks 34 *and* 35.

139...	Road........	Sta. 8+ 2 to 8+35.	Whipple wooden truss....................	Wood....	72	6
140...	Farm........	Sta. 45 36 to 45 64.	Whipple wooden truss....................	Wood....	81	
141...	Farm........	Sta. 71 56 to 71 82.	Whipple wooden truss....................	Wood....	71	
142...	Road........	Sta. 94 4 to 94 30..	Whipple wooden truss....................	Wood....	71	
143...	Farm........	Sta. 128 32 to 128 57..	Whipple wooden truss....................	Wood....	71	3
144...	Farm........	Sta. 173 95 to 174 20..	Whipple wooden truss....................	Wood....	72	
145...	Farm........	Sta. 217 40 to 217 62..	Whipple wooden truss....................	Wood....	70	
146...	Farm........	Sta. 241 40 to 241 65..	Whipple wooden truss....................	Wood....	70	

Between Locks 35 *and* 36.

147...	Farm........	Sta. 34+85 to 35+10.	Whipple wooden truss....................	Wood....	70	
148...	Farm........	Sta. 71 12 to 71 35..	Whipple wooden truss....................	Wood....	72	
149...	Farm........	Sta. 216 45 to 216 70..	Whipple wooden truss....................	Wood....	71	6
150...	Road........	Sta. 289 91 to 290 21..	Whipple wooden truss....................	Wood....	72	6

BRIDGES — (Continued).

Between Locks 38 *and* 39.

Number.	NAME.	Location.	Plan.	Material.	Span.	
					ft.	in.
151...	Tow-path	Sta. 2+75 to 3+ 7.....	Wood over Little Falls side cut.............	Wood....	......	
152...	Road	Sta. 7 65 to 8 10.....	Cast iron pipe arch truss..................	Iron.....	73	
Between Locks 39 *and* 40.						
153...	Road	Sta. 6+2 to 6+30..	Whipple wooden truss.....................	Wood....	77	6
154...	Road	Sta....	Wrought iron lattice, village Little Falls	Iron.....	......	
155...	Farm........	Sta. 97 32 to 97 60..	Whipple wooden truss.....................	Wood....	73	
156...	Farm........	Sta. 178 25 to 178 52..	Whipple wooden truss.....................	Wood....	72	
Between Locks 40 *and* 41.						
157...	Farm........	Sta. 72+ 92 to 73+16 .	Whipple wooden truss.....................	Wood....	72	6
158...	Farm........	Sta. 160 40 to 160 66..	Whipple wooden truss.....................	Wood....	70	6
159...	Farm........	Sta. 197 20 to 197 52..	Whipple wooden truss.....................	Wood....	72	
Between Locks 41 *and* 42.						
160...	Farm........	Sta. 30 + to 30+26..	Whipple wooden truss.....................	Wood....	71	
161...	Road	Sta. 109 to 109 50..	Whipple wooden truss.....................	Wood....	70	6
162...	Road	Sta. 180 28 to 181 3 .	Whipple cast iron arch truss	Iron	79	
163...	Farm........	Sta. 223 12 to 223 40..	Whipple wooden truss.....................	Wood....	75	6

Between Locks 43 and 44.

164...	Farm........	Sta. 31+ 8 to 31+40 .	Whipple wooden truss....................	Wood....	76	6
165...	Street........	Sta. 67 70 to 67 96 .	Whipple wooden truss....................	Wood....	72	
166...	Street........	Sta. 86 92 to 87 72 .	Cooper wrought iron arch truss.............	Iron	73	
167...	Street........	Sta. 107 92 to 108 25..	Mosely wrought iron arch truss.............	Iron	72	
168...	Farm........	Sta. 150 47 to 150 75..	Whipple wooden truss....................	Wood....	71	6
169...	Road	Sta. 185 40 to 186 32..	Phœnix trapezoidal iron truss......	Iron	117	
170...	Road	Sta. 197 24 to 197 68..	Whipple cast iron arch truss	Iron	74	

Between Locks 44 and 45.

171...	Farm........	Sta. 11+32 to 11+60....	Whipple wooden truss....................	Wood....	72	6
172...	Farm........	Sta. 45 60 to 45 90....	Whipple wooden truss....................	Wood....	75	6
173...	Street........	Sta. 77 12 to 77 46....	Whipple wooden truss....................	Wood....	72	
174...	Road	Sta. 91 36 to 91 90....	Whipple wooden truss....................	Wood....	78	3

Between Lock 45 and East Line of Oneida county.

175...	Road	Sta. 6+52 to 7+ 8..	Whipple cast iron arch truss	Iron	72	
176...	Farm........	Sta. 37 12 to 37 42..	Whipple wooden truss....................	Wood....	72	
177...	Road	Sta. 74 40 to 74 70..	Whipple wooden truss....................	Wood....	74	
178...	Farm........	Sta. 96 15 to 96 40 .	Whipple wooden truss....................	Wood....	70	6
179...	Farm........	Sta. 139 16 to 139 40..	Whipple wooden truss....................	Wood....	71	3
180...	Farm........	Sta. 186 92 to 187 17..	Whipple wooden truss....................	Wood....	69	6
181...	Farm........	Sta. 217 70 to 217 95..	Whipple wooden truss....................	Wood....	70	
1-2...	Farm........	Sta. 296 60 to 296 85..	Whipple wooden truss....................	Wood....	71	
183...	Farm........	Sta. 327 95 to 328 20..	Whipple wooden truss....................	Wood....	71	
184...	Farm........	Sta. 363 76 to 364 4...	Whipple wooden truss....................	Wood....	72	
185...	Farm........	Sta. 386 94 to 387 18..	Whipple wooden truss....................	Wood....	70	
186...	Road	Sta. 441 88 to 442 16..	Whipple wooden truss....................	Wood....	72	6
187...	Road	Sta. 466 40 to 466 65..	Whipple wooden truss....................	Wood....	72	6
188...	Farm.... ...	Sta. 495 55 to 495 80..	Whipple wooden truss....................	Wood....	71	9

BRIDGES — (Continued.)

There are, in addition to those in the table, bridge over entrance to Albany weigh lock, iron pipe truss, span 42 feet.

Number.	NAME.	Location.	Plan.	Material.	Span.
			Between Locks 18 and 19.		
					ft. in.
......	....	Sta. 20+30	Suspension foot bridge (private)	....	......
......	....	Sta. 250 67	Suspension foot bridge (private)	....	......
......	....	Sta. 251 6	Noxon's dry dock double lift bridge	....	......
......	....	Sta. 274 80	Suspension foot bridge (private)	....	......
......	....	Sta. 303 80	Suspension foot bridge (private)	....	......
......	....	Sta. 315 30	Suspension foot bridge (private)	....	......
			Between Locks 30 and 31.		
......	....	Sta. 384+80	Foot bridge, wooden Whipple (private)	Wood	......
......	....	Sta. 402 36	Foot bridge, wooden Whipple (private)	Wood	......
			Between Locks 31 and 32.		
......	....	Sta. 267 1-2	Foot bridge, wooden Whipple (private)	....	......
......	....	Sta. 285 1-2	Foot bridge, wooden Whipple (private)	....	......
			Between Locks 32 and 33.		
......	....	Sta. 22+95	Suspension bridge, iron	....	......
			Between Locks 34 and 35.		
......	....	Sta. 128+32	Bridge over feeder	Wood	30′
......	....	Sta. 173 95	Bridge over feeder	Wood	30′

			Between Locks 35 *and* 36.		
......	....	Sta. 286+35	Suspension foot bridge	Wood....	......
			Between Locks 39 *and* 40.		
......	....	Sta. 64+20	Two abutments, no bridge	....	......
			Between Locks 40 *and* 41.		
......	....	Sta. 48+68	Suspension foot bridge, wood, Whipple (p'v't)	Wood....	......
......	....	Sta. 12 70	Two abutments, no bridge	....	......
			Between Locks 41 *and* 42.		
......	....	Sta. 46+75	Suspension foot b'ge, wooden, Whipple (p'v't)	....	......
......	....	Sta. 130 5	Suspension foot b'ge, wooden, Whipple (p'v't)	....	......
......	....	Sta. 211 70	Suspension foot b'ge, wooden, Whipple (p'v't)	....	......
			Between Locks 45 *and* 46.		
......	....	Sta. 380+90	Pillars for foot bridge, no bridge	....	......
......	....	Sta. 415 30	Suspension foot bridge	....	......

NOT NUMBERED.

NAME.	Location.	Plan.		Material.
Railroad	Between Schenectady and Hoffman's	Wrought iron	B. H. T. & W. R.	Iron.
Railroad	Below lock No. 32	Wrought iron	N. Y., W. S. & B. R	Iron.
Railroad	One and three-fourths miles above lock No. 32	Wrought iron	N. Y., W. S. & B. R	Iron.
Railroad	At Mohawk	Wrought iron	N. Y., W. S. & B. R	Iron.
Railroad	Ferguson's Creek below Utica	Wrought iron	N. Y., W. S. & B. R	Iron.

ERIE CANAL — BRIDGES.

The bridges on this division of the Erie canal are for the most part in good condition.

Numbers 61, 112 and 113 should be rebuilt.

Several bridge abutments on the berme side of the canal are considered in a dangerous condition, and many others are gradually becoming unsafe in consequence of having settled and being crowded over by the embankment. Some are now leaning into the canal with the masonry overhanging from three to fifteen inches. These abutments may be brought nearly into their original position, especially where the masonry is not broken or displaced, by removing the embankment back of them and excavating under the rear of the foundation, allowing that portion to settle, thus bringing them into place.

This was done during the year at bridge 115, the first above Meyers' creek aqueduct, and has proved to be a good strong piece of work.

Some of the abutments have portions of the masonry and coping displaced and need pointing.

All of the old abutments being too low to give twelve feet clearance from the water surface to the lowest points of the bridges, have been blocked up with wood and should be lengthened and raised with stone. This can be done by making the slope of the steps for three or four courses from the top, one to one.

I would recommend, as my predecessors have, that iron bridges be substituted to take the place of the wooden ones now in use.

From Schoharie Creek to Canajoharie, the bridge abutments have been thoroughly repaired and repointed, greatly improving the strength and appearance of the structures.

One and one-quarter miles west of Little Falls, the village of Little Falls constructed an iron highway bridge and abutments during the year.

ERIE CANAL — PRISM AND BANKS.

The prism is in fair condition. The slope wall needs repairing from a point two feet below the surface of the water. The tow-path banks are in many places low and are being raised. The Superintendent of Public Works is now using four large boats on this work, and by another season will have them at their proper height; when this is done the slope walls should be carried up and the pavement relaid.

The vertical walls require constant repairs, much of it having been improperly constructed and of a poor quality of stone.

Much of the docking is in bad condition, being very much decayed and should be renewed. That portion of the Schenectady level from the city west nearly two miles was originally constructed with timber and plank docking on both sides of the canal, which has now become old and unsafe and requires constant attention. I would respectfully recommend, that a vertical wall in cement, placed on a broad timber foundation, be constructed in place of this docking.

Another similar piece of docking has been in use for some time on the inside of the tow-path at Big Nose. This is more dilapidated than that at Schenectady, and has portions leaning into the canal which may fall in if not soon attended to. I would recommend a similar vertical wall to be constructed at this point, also that the leaky places in the bottom of the canal at this point be covered with concrete.

Between locks 20 and 21 on the berme side, the slate rock which gave so much trouble creating bars has been dredged out which has greatly improved this portion of the canal.

ERIE CANAL — BREAKS.

Two breaks have occurred on this canal during the year; the first on the fourteen mile level, June 18, at a point about 100 feet west of the first waste-weir below lock 31, on the tow-path side, delaying navigation but for a few days. It started Tuesday night at 11:30 and was caused by muskrats burrowing in the bank. The opening was about twenty feet long and five feet deep, about 350 cubic yards of embankment being washed out. The promptness and efficiency of the section superintendent prevented a serious delay. A dam was thrown across the break and material being obtained within a distance of 500 feet, by Wednesday, P. M., water was let into the level. During the repairs it was found that muskrat holes extended in all directions through the bank at this place.

The second break occurred on the berme side, between locks 18 and 19, over the culvert next to Clutes Dry Dock on Tuesday, August 12. The water broke through the bottom of the canal over the culvert, which has a wooden trunk, and following the same, worked under the parapet and wing walls, causing so much settlement that it will be necessary to rebuild the same; a crib was built in the canal around the damaged portion and filled with puddled clay. This caused about one week delay. The work was thoroughly done under the direct supervision of Assistant Superintendent of Public Works, J. D. Hancock.

CHAMPLAIN CANAL.

This canal, though still badly needing extensive repairs, is in much better condition than at the close of the last year. Little permanent improvement has been effected out of the ordinary repair fund, as the mere keeping of it in navigable condition taxes this fund to its utmost limits. Both tow-path and berme banks are largely made of clay and sand without either timber or stone protection. A large portion of the tow-path was originally protected with a slope wall and dock stick, but the slope wall having been built when there was only five feet of water carried in this canal, the prism is now excavated below this wall which is in many places in a dilapidated condition, and the dock sticks rotten and useless. In consequence of this fact, the water is gradually but constantly encroaching on the banks, thus narrowing the tow-path and endangering the stability of the embankments, and also filling in the bottom of the canal and thus decreasing the depth of water therein. The masonry on this canal is in very fair condition; during the past five years much of it has been rebuilt, and much more is now under contract.

CHAMPLAIN CANAL — DAMS.

Number 1 is located at Troy, across the Hudson river. The dam is 1,100 feet long and eleven feet high ; it is built of timber cribs filled with stone and covered with timber drift bolted, binding the cribs together. These timbers, together with the longitudinal timbers to which they are bolted, have become very much worn and some of them are loose and liable to be washed out at times of freshets, and have already caused many leaks.

The covering of the dam should be removed, the cribs repaired and a new hard wood or a Georgia pine timber covering put on. The upper side of the dam should be repaired and thoroughly lined with gravel to stop the numerous leaks.

I would recommend that gravel and brush be put in at the upper side of the dam to stop the leakage. The river channel below the lock could be dredged out and straightened, and the material thus obtained be transported through the sloop lock and dumped on the upper side of the dam. The sloop lock pier which is the east anchorage of the dam has been thoroughly repaired and strengthened this year by means of a new crib of timber and stone placed on the outside, and running from the line of the crest of the dam along the west and south face of the old pier to the foot of the lock.

Number 2 is located at Cohoes in Albany county, across and at the mouth of the Mohawk river, built on solid rock. The abutments and and dam proper are of cut stone, with an apron of timber and stone cribbing. The ridge of the dam is 1,616 feet long and twelve feet high. About seventy-five feet of the apron at the north end was washed out by the spring freshets, and one coping stone broken and carried away ; this has all been repaired and the structure is now in good condition.

Number 3, known as the Saratoga Dam, is located at Northumberland, in Washington and Saratoga counties, across the Hudson river. The entire structure is of cut stone on a rock foundation, the dam itself being 740 feet long and twelve feet high, is a substantial structure in good condition.

Number 4 is located near Fort Ann, in Washington county, on the berme side of the canal across Wood creek, near the head of lock 19. This is a stone dam with cut stone abutments, having a spillway of 120 feet and is in fair condition. Some of the masonry has been displaced and the structure needs pointing.

Nos. 5, 6 and 7 are located just south of Lock No. 20, across branches of Wood Creek. No. 5 is a cut stone dam and abutments with a spillway of sixty feet in fair condition. No. 6 is a cut stone dam and abutments with a spillway of forty-eight feet in fair condition. No. 7 is a tree dam with a spillway of 110 feet, has rubble masonry abutments and is in fair condition.

No. 8 is located about two miles west of Glens Falls, in Warren county, across the Hudson river. This dam is composed of timber cribs filled with stone, covered with timber, and built on a rock foundation. The dam proper is 618 feet long, fourteen feet high and raises the water about ten feet. The abutments and feeder bulkhead are of cut stone. The old dam was constructed many years since, but within a few years has been rebuilt, making it double the original width, also increasing the elevation.

CHAMPLAIN CANAL – LOCKS.

There are eighteen lift and five guard locks on the Champlain canal. Two of the guard locks are at the Mohawk river, at Cohoes; two at the Hudson river, at Northumberland, and one about half way between Fort Ann and Whitehall, near the Wood Creek feeder dams.

There are also three lift locks combined on the Waterford side cut and one weigh lock at Waterford. All of the above mentioned locks are 110 feet by 18 feet each in the chamber with various lifts, as shown by the accomyanying table. All the locks are on the enlarged plan and of the same size as those on the Erie canal.

There is also one river lock at the head of navigation on the Hudson connecting with the pond above the Troy dam, which is 115 feet by 30 feet in the chamber.

CHAMPLAIN CANAL – LOCKS.

Number.	NAMES.	Feet, lift.
1.	Cohoes lock	+11.5
2.	Cohoes lock	+11.5
3.	Guard lock, south side Mohawk river	0.0
4.	Guard lock, north side Mohawk river	—0.280
5.	Lock above Waterford	+13.270
6.	Lock above Waterford	+11.348
7.	Flynn's lock	+9.288
8.	Hewett's lock	+11.095
9.	Becker's lock	+8.297
10.	South guard lock, Northumberland	0.0
11.	Saratoga guard lock, Northumberland	+9.92
12.	Bassett's lock	+9.295
13.	Fort Miller lock	+9.787
14.	Moses Kill lock	+9.098
15.	Fort Edward, summit level	+8.00
16.	Upper combined, Fort Ann	—8.24
17.	Lower combined, Fort Ann	—8.137
18.	Lower combined, Fort Ann	—7.109
19.	Parish lock, Wood Creek	—2.045
20.	Guard lock, Wood Creek	—0.138
21.	First combined, Whitehall	—9.00
22.	Second combined, Whitehall	—9.00
23.	Third combined, Whitehall	—10.00

There is one guard and thirteen lift locks on the Glens Falls feeder, each of which, with the exception of Lock No. 11, which is 110 feet by 18 feet, is 100 feet by 15 feet in the chamber, making a total of forty-one locks on the Champlain canal and Glens Falls feeder. Locks No. 1, 2, 5, 6, 7, 8, 9, 13 and 14 on the Champlain canal and No. 11 on the Glens Falls feeder have tumble gates at the upper end, all the rest have mitre gates.

Lock No. 9 is in very bad condition; there are leaks on both sides of the lock in the chamber for the full length; the joints are all open, and when the lock is full the water penetrates back of the walls and discharges at the foot of the embankment in a large stream. There also seems to be a leak at the head of the lock; the walls bulged in and it was found necessary to dress off the face on the berme side. I would recommend that cut-offs, on both sides at the upper end, of masonry or clay puddle be put in, also that the joints be thoroughly pointed with neat Portland cement mortar and that the back of the walls be stripped of earth, and grouted masonry be built against them. This should be done at the close of navigation.

No. 10 has been put in good condition during the past year. Stop gate was put in at head of lock.

The rest of the locks are in fair condition with the exception of pointing and repairs to gates and wickets.

Nearly all the locks need pointing.

GLENS FALLS — FEEDER.

Number.	DESCRIPTION.	Feet. lift.
1.	Lower lock	10
2, 3.	Combined locks.	10 10
4.		10
5.		10
6, 7, 8, 9, 10.	Combined locks..	10 10 10 10 10
11.		11
12.		12
13.		10
14.	Guard lock at dam	

No. 4 is in bad condition; the upper end should be rebuilt on the enlargement plan and some of the stone on the lower end replaced.

The upper end of lock No. 10 was rebuilt on the enlargement plan during the year.

The rest of the locks are in fair condition, except that the joints need repointing.

The chamber walls of all except Nos. 5, 11 and 14, are too low and should be raised with stone.

The wooden sluiceway around Locks 2, 3, and 4 should be rebuilt, as it is much decayed.

CHAMPLAIN CANAL — AQUEDUCTS.

There are four aqueducts on this canal. The first located at Schuylerville; the second on the level between Locks Nos. 12 and 13; the third two or three hundred feet above Lock No. 14, and the fourth at Fort Edward.

No. 1, The north berme wing of masonry has been crowded over; some stone are displaced on the north tow-path wing which should be relaid and masonry pointed.

No. 2, The south wing on tow-path side, twenty-seven feet long, is settling and bulging out, and a portion of the parapet wall and arch is breaking up and will need relaying to put the structure in complete repair. The berme side masonry is in good order.

No. 3. The foundation of the berme end of the north abutment and wing, which is placed on a shelf of the rock, has crumbled away and the masonry is settling; this should be repaired and all the masonry thoroughly pointed. When all the material is removed from canal bottom the trunk will need lowering several inches, making it necessary to remove the trunk and cut down the masonry.

No. 4. Masonry needs pointing and two new vertical wing walls added on tow-path side.

CHAMPLAIN CANAL — WASTE-WEIRS.

There are twenty-seven waste-weirs on the Champlain canal, and one on the Glens Falls feeder.

Appropriations have been made and contracts let for rebuilding the following waste-weirs:

Burton's, at Waterford; waste-weir between Locks 11 and 12; waste-weir at Lock 20; Eastman's waste-weir; also for building a new spillway between Locks 5 and 6.

The waste-weir between Locks 8 and 9, just north of Mechanicville, is in a very bad condition and should be rebuilt. The stones are displaced and water leaks through nearly every joint.

The waste-weir at Lansing's mill, at Stillwater, should be rebuilt; is in the same condition as last mentioned.

Empie's waste-weir, the first south of Lock 16, leaks badly and is in a dangerous condition. The masonry has settled badly and should be rebuilt at the close of navigation.

There is only one waste-weir on the Glens Falls feeder, located at Finch, Pruyn & Company's lime-kiln, on the tow-path side, constructed of cut stone, has an arch of eight-foot chord, with bulk-head and spillway twelve feet wide. The masonry is in bad condition and should be rebuilt.

CHAMPLAIN CANAL — CULVERTS.

There are twenty-six culverts on the Champlain canal; nineteen under the canal, two through the tow-path in the river at Northumberland, two for highways over stream at Waterford, one for feeder at Lock No. 4, two for feeders at Lock No. 10, and also three on the Glens Falls feeder.

Appropriations have been made and contracts let for rebuilding and lengthening the following culverts:

At Thorne's lane, above Lock No. 6, tow-path to be straightened, old wooden trunk removed, and a new diving culvert of stone constructed at right angles to the new inner angle.

The old culvert, three-quarters of a mile south of Fort Miller lock, is to be removed and a new stone diving culvert constructed.

Iron Pipe culvert, three-quarters of a mile north of Moses Kill lock; culvert to be lengthened on berme side so that the bank can be widened and strengthened.

Lander's culvert, between Locks 14 and 15; to be lengthened on the berme side so that the berme bank of the canal can be widened and strengthened; a much needed improvement.

There are only three culverts proper on the feeder; one of cement pipe, twelve inches in diameter, under the canal at Sherman's dry dock; a small stone-box culvert at bridge 115, through the tow-path, for draining level and bottoming the same; also one between Locks 13 and 14, at Brown's bridge, a box culvert with three feet opening. All these in fair condition.

CHAMPLAIN CANAL AND GLENS FALLS FEEDER — BRIDGES.

There are one hundred and fifty-three bridges on the Champlain canal, which includes the bridge across the Mohawk river at Cohoes. There are eleven on the Glens Falls feeder.

In addition to the above-numbered bridges, there are nine railroad bridges, located as follows:

One above the weigh-lock at Waterford, Rensselaer and Saratoga railroad.

One at Mechanicville, Rensselaer and Saratoga railroad.

One between Mechanicville and Lock 9, Boston, Hoosac Tunnel and Western railroad.

One at Fort Edward, Rensselaer and Saratoga railroad.

One at Fort Edward, Glens Falls branch of Rensselaer and Saratoga railroad.

One at Fort Ann, Rensselaer and Saratoga railroad.

Two between Lock 20 and Whitehall, Rensselaer and Saratoga railroad.

One at Whitehall on Rutland branch of Rensselaer and Saratoga railroad.

The Waterford railroad bridge is low and should be raised about one foot.

The railroad bridge on the Rutland branch at Whitehall is low and should be raised four inches.

The Curtis farm bridge above Bemis Heights is low and should be raised six inches.

Appropriations have been made and contracts let for rebuilding the following bridges and raising abutments:

Continuation of Arch street, Green Island, tow-path and berme abutments, and iron highway bridge 100 feet clear span, appropriation of $6,000 made by Legislature April 15, 1884.

The following are paid for from the extraordinary repair fund re-appropriated by the Legislature April 22, 1882:

Tow-path abutment raised, new berme abutment and superstructure at Division street, Waterford; work completed except a few steps on berme abutment.

Second bridge above Lock 6, new tow-path abutment.

Second bridge south of Lock 9, new tow-path and berme abutments.

New tow-path abutment and superstructure at Stillwater.

First bridge north of Stillwater, new berme abutment and tow-path abutment to be raised.

Two and one-half miles south of Schuylerville, new tow-path and berme abutments and superstructure.

First bridge north of Lock 14, new tow-path abutment and bridge; two new abutments and bridge over escape to waste-weir No. 12.

Bridge No. 96, new berme abutment and bridge; also raising tow-path abutment.

At mouth of Glens Falls feeder, new tow-path and berme abutments and new bridge.

Fifty feet north of Lock 20, new tow-path and berme abutments and new bridge. This is a change bridge and the old change bridge at the mouth of the Glens Falls feeder is to be used here.

Eleven chains north of Lock 20, new tow-path abutment and new bridge. At present this is used as a road and change bridge, and will be used as a road bridge. The change bridge will be placed, as stated above, fifty feet north of the lock.

At first railroad bridge north of Lock 20, new tow-path abutment and bridge.

One mile south of Whitehall, new berme abutment and bridge.

The following bridges and abutments need repairs:

The tow-path and highway bridge across the Mohawk river, at Cohoes, has been repaired and put in as good condition as possible. This bridge is a post combination truss bridge of wood and iron, built in 1872; most of the wood-work should be renewed. The end posts which were rotting away at the foot have been spliced and the flooring renewed this year. Permission has been granted the Cohoes and Waterford Horse Railway to cross, and tracks have been laid on the west side.

Fisher's bridge, below Lock No. 7; the tow-path abutment should be set back so as to give more room between the inner angle of the towing-path and the abutment; as it is now there is scarcely eight feet. This improvement will necessitate the building of a new bridge.

The same recommendations apply to Powers bridge.

Best's bridge opposite the Pulp mills, in Mechanicville, should be repaired and the tow-path abutment rebuilt. This bridge was intended for farm uses, but since the Boston, Hoosac Tunnel and Western Railroad has been completed, side tracks have been laid on the berme side of the canal at this point, and much heavy teaming is done over this bridge and as it now stands it is in a dangerous condition. The tow-path abutment is badly cracked, caused by settlement of the foundation and the face has separated from the backing.

The berme abutment of Baldwin's bridge above Bemis Heights is in bad condition and should be rebuilt, also, the tow-path abutment is low and should be raised.

First bridge north of Ensign's tile works. The tow-path abutment was laid dry with no mortar, and is in bad condition. I would recommend that the bridge be abandoned and the superstructure and material used in some other place. This bridge has not been used for a long time and the land owner says he would not use it if it was put in good condition.

Bridge No. 60. The berme abutment needs repairs, several stones have been knocked out of the wings by passing boats. The superstructure also needs repairs. The bottom chord on the north side is broken and has been repaired temporarily.

Many of the bridges have sway braces of wood; these should be replaced with iron.

Many of the abutments are low, the bridges being placed on blocks of wood; these should be raised with stone.

The following bridges have been rebuilt and paid for from the ordinary repair fund, by the Superintendent of Public Works:

Road bridge on Fourth street over Waterford sidecut; road bridge at Burton's saw mill, Waterford; Road bridge with one sidewalk at Cemetery street, Mechanicville; road bridge with one sidewalk, William street; Mechanicville and Stratton's road bridge No. 39, also the approaches to Searles road bridge have been widened.

GLENS FALLS FEEDER — BRIDGES.

The berme abutment at Green's bridge should be rebuilt, the lower part being nothing more than the vertical wall of the prism, and is liable to bulge into the canal and damage the bridge.

The remainder of the bridges and abutments are in good condition.

CHAMPLAIN CANAL — PRISM AND BANKS.

The prism has been much improved in a few places and contemplated improvements under contract will add much to increasing the capacity of the same. The banks are in many places too low for the quantity of water they have to sustain and are higher on the outer than on the inner angles, thus allowing a great amount of material to wash into the prism. The bottom width of the canal could be increased in many places by dredging on the berme side. The docking is in very bad condition and cannot be renewed unless the walls are repaired and carried up high enough to support it.

The prism and banks on the Glens Falls feeder are in fair condition, except between Glens Falls and the guard lock. This part should be bottomed out and the ridges of rock on the bottom near the guard lock be removed.

CHAMPLAIN CANAL — BREAKS.

The only delay to navigation on this canal was on the sixteen mile level, caused by a break through the tow-path bank at Costello's grocery, at Coveville, three and one-half miles south of Schuylerville. This occurred on the morning of June 9th, causing a detention of two weeks, navigation not being resumed until June 23d. A section of the tow-path bank 100 feet long on the bottom, 170 feet long on top and twenty feet deep was carried into a branch of the river which extends to the foot of the slope. The prism and banks were badly damaged for a distance of 700 feet above and 1,000 feet below the break, twenty-five thousand cubic yards of material being carried into the river.

A strong timber crib, filled with stone, was constructed in the break about twelve feet back of the inner angle, sheet piled at the foot and lined on the face with matched plank and filled in front with puddled clay. The filling for the prism and bank was obtained near at hand. The bank as built has stood from that time with no slope wall protection and with no leakage under or through the crib.

This bank has always been unsafe, four serious breaks having occurred here before; the bottom is a quicksand forming a poor foundation. An appropriation has been made and contract let for strengthening this bank for its entire length by means of piles at the foot of the slope, driven close together and extending three feet out of the ground, to support the lower side of stone filling to weight the bank; this filling will average about two cubic yards to the running foot. I would recommend that a slope wall be put in the prism on the tow-path, to protect the bank from wash.

CHAMPLAIN CANAL — ORDINARY REPAIRS.

Some bottoming out has been done, also raising banks. Lock No. 9 was repointed and part of the face on the west side of the lock dressed off. The tow-path bank from lock 20 to Whitehall has been put in fair condition; more State scows should be furnished on this canal to boat the material needed for graveling the banks.

CHAMPLAIN CANAL — EXTRAORDINARY REPAIRS.

Under act, chapter 97, Laws of 1882, the sum of $199,877.80, being the unexpended balance of the sum of $500,000 appropriated by act, chapter 399, Laws of 1874, for the improvement of the Champlain canal, was reappropriated to be expended under the direction of the canal board for continuing the improvement of the Champlain canal and Glens Falls feeder; this unexpended balance with interest up to Oct. 1, 1883, amounted to $201,283.66.

By resolutions of the canal board the following amounts have been set aside from the above unexpended balance to continue the improvement of the Champlain canal and Glens Falls feeder, necessary engineering expenses included in each piece of work.

No.	DESCRIPTION.	When appropriated by canal board.	Amounts.
1.	For widening and improving the Champlain canal south lock No. 5.	Dec. 28, '82.	$1,536 98
2.	For widening and improving the Champlain canal in the village of Waterford between Broad and Division streets	Dec. 28, '82.	8,676 75
3.	Rebuilding waste-weir at Burton's mill, Waterford	Jan. 15, '84.	4,976 00
4.	Building spillway between locks 5 and 6.	Jan. 15, '84.	3,166 00
5.	Widening and deepening prism also building one new tow-path bridge abutment and one superstructure at Stillwater	Jan. 15, '84.	19,485 00
6.	Improving prism, including one bridge superstructure and its abutments at Coveville	Jan. 15, '84.	29,463 00
7.	Rebuilding waste-weir above lock 11.	Jan. 15, '84.	2,249 00
8.	Strengthening berme bank and rebuilding culvert 3-4 mile south of Fort Miller lock	Jan. 15, '84.	3,770 00

No.	DESCRIPTION.	When appropriated by canal board.	Amounts.
9.	Improving prism and banks 1-4 mile south of Moses Kill lock........	Jan. 15, '84.	$1,725 00
10.	Strengthening banks between Moses Kill lock and Moses Kill aqued't.	Jan. 15, '84.	650 00
11.	Strengthening berme bank 3-4 mile north of Moses Kill lock........	Jan. 15, '84.	1,344 00
12.	Improving prism and banks at Woodchuck Point..............	Jan. 15, '84.	8,660 00
13.	Improving prism, including one bridge superstructure and one bridge abutment at foot of Glens Falls feeder....................	Jan. 15, '84.	2,252 00
14.	Building new tow-path and change bridge at lock 20..........	Jan. 15, '84.	5,912 00
15.	Rebuilding Eastman's waste-weir 2½ miles south of Whitehall........	Jan. 15, '84.	5,084 00
16.	Improving prism, one mile south of Whitehall, including one bridge superstructure and one berme bridge abutment...............	Jan. 15, '84.	2,906 00
17.	Improving prism between bridges 139 and 140 near Whitehall.....	Jan. 15, '84.	11,900 00
18.	Building bridge and abutments, over escape to waste-weir No. 12......	Jan. 15, '84.	343 00
19.	Improving prism at railroad bridge north of lock 20................	Jan. 15, '84.	7,365 00
20.	Improving prism and building docking at Smith's Basin............	Jan. 15, '84.	930 00
21.	Building four tow-path and three berme bridge abutments	Jan. 15, '84.	8,575 00
22.	Widening and improving the canal south of Fort Miller lock........	Jan. 22, '84.	1,545 00
23.	Widening and improving the canal at bridge No. 95 (erroneously stated as bridge 94 in Canal Board proceedings)......................	Jan. 22, '84.	470 00
24, 25, 26.	Strengthening the leaking banks of the Glens Falls feeder, between Greens bridge and Finch & Pruyns' mill at Glens Falls. Widening the upper end of lock No. 10, Glens Falls feeder. Widening and strengthening sluice at head of Fort Edward lock.......	Aug. 6, '84.	5,184 91
27.	Balance needed to finish the proposed improvement at Waterford (No. 2, of this list)..................	Aug. 6, '84.	906 74
28.	Balance needed to finish proposed improvement, rebuilding Eastmans waste-weir (No. 15, of this list)	Aug. 6, '84.	3,630 29

No.	DESCRIPTION.	When appropriated by Canal Board.	Amounts.
29.	Strengthening sloop lock at the Troy dam	Sept. 16, '84.	$5,526 08
30.	Raising two tow-path abutments and approaches, also for rebuilding one tow-path abutment and approach, and for building two wooden bridges	Sept. 16, '84.	2,787 85
31.	Strengthening 7½ chains of berme bank at Mechanicville	Sept. 16, '84.	4,504 75
32.	Widening 11 chains of canal at Woodchuck Point	Sept. 16, '84.	2,597 95
33.	Improving 11 chains of canal between bridges 140 and 141, near Whitehall	Sept. 16, '84.	4,185 00
34.	Improving 18 chains of canal near the railroad bridge at Whitehall	Sept. 16, '84.	12,192 00
35.	Rebuilding culvert and improving 3 chains of canal at Thorne's lane, above lock No. 6	Sept. 16, '84.	5,424 00
36.	Strengthening tow-path bank near Coveville	Sept. 16, '84.	6,689 20
37.	Improving 11½ chains of Glens Falls feeder at Finch & Pruyns Lime Kiln, Glens Falls	Sept. 16, '84.	6,019 50
38.	Rebuilding waste-weir near lock No. 20	Sept. 16, '84.	3,102 74
39.	Balance needed to complete proposed improvement of 18½ chains near Whitehall (No. 16 of this list)	Sept. 16, '84.	190 41
	Total amount appropriated		$195,925 15

From this total the amount appropriated by the Canal Board January 15, 1884, for the Woodchuck Point improvement (No. 12 of this list), is to be deducted; the plan was changed and the amount stated in No. 32 was appropriated by the Canal Board at the meeting held September 16, 1884	8,660 00
Total amount appropriated for the thirty-nine items; No. 12 omitted	$187,265 15
To the unexpended balance on hand October 1, 1883	$201,283 66
Add interest from October 1, 1883, to October 1, 1884.	5,712 61
Total available for improvements	$206,996 27
Deduct amount appropriated as shown above	187,265 15
Total remaining available for further improvements	$19,731 12

DESCRIPTION OF THE CHAMPLAIN CANAL IMPROVEMENTS.

1. This improvement is on the tow-path, beginning sixteen chains south of hollow quoin of lock No. 5, and runs south from this point six chains. The bend in the tow-path is straightened, the canal widened and new tow-path bank constructed, and six chains of slope wall built.

2. This improvement is on the berme side at Waterford, beginning just below the Broad street bridge and running to a point three chains above the Division street bridge. The canal to be widened, vertical wall in cement put in for the whole distance and to run in front of the abutments so as to give an unbroken passage for boatmen who wish to tie up, the Waterford weigh-lock being located just above the work. The berme abutment of the Division street bridge is to be set back and rebuilt so as to give a clear span of sixty-six feet, and a new superstructure to be built with a sixteen-foot roadway and five-foot sidewalk, also the berme approach to be raised.

3. Rebuilding Burton's waste-weir at Burtons mill, Waterford. This will be built on an improved plan having wrought-iron lift gates and a logway constructed, which will reduce the amount of water spilling over the same.

4. Building spillway between locks 5 and 6; to discharge the surplus water that accumulates on this level when the locks are operated and endangers the tow-path.

5. Improvement at Stillwater. Bends on the tow-path and berme to be straightened, and canal widened. The inside slope of the tow-path from Sta. 0 to Sta. 3, to be 1¼ slope protected with slope wall; from Sta. 3 to Sta. 4, with vertical wall in cement; from station 4 to station 22, the inner slope of tow-path to be 1 to 1 with vertical wall in cement placed on a bench five feet above canal bottom, with Norway pine coping timbers and oak ties on top of wall; from station 22 to 23, vertical wall in cement from canal bottom; station 23 to 28 with vertical wall on bench as described above, and from station 28 to 34 with slope wall same as described from station 0 to station 3. The berme side from station 3+60 to 9+60 to have vertical wall in cement and the rest of the distance will have no protection. This improvement includes the moving back and rebuilding the tow-path abutment, and constructing a new bridge of sixty-two-foot span and twelve foot clear roadway. Stations run north; Sta. 0 is centre of culvert.

6. Improvement at Coveville. Sta. 0 is center of culvert; stations runs north. Tow-path bends straightened and canal widened on berme side from Sta. 0 to Sta. 18. A new piece of canal is to be constructed from Sta. 21 to Sta. 26. From Sta. 26 to Sta. 54, bends on tow-path and berme to be straightened. From Sta. 1+50 to Sta. 21, inside slope of tow-path to be one and one-fourth to one, protected with slope wall. From Sta. 21 to Sta. 26, inside slope of tow-path to be one to one, with a vertical wall in cement placed on a bench five feet above canal bottom, with Norway pine coping timbers on top of same. From Sta. 26 to Sta. 54, slope wall as described above. The berme side will need only two chains of protection wall to be used near the culvert.

7. Rebuilding waste-weir above lock No. 11. The work is on the tow-path side and consists of rebuilding an abandoned waste-weir with a structure on an improved plan, having improved wrought-iron lift gates.

8. Rebuilding culvert and strenghtening bank, three-fourths of a mile south of Fort Miller. A stone diving culvert to be constructed and twelve chains of berme bank to be strengthened by embankment.

9. Improvement one-fourth mile south of Moses Kill lock. Widening canal by excavating six chains of rock on the berme side.

10. Improvement between Moses Kill lock and Moses Kill aqueduct. Strenghtening six chains of tow-path and berme banks with embankment.

11. Improvement three-fourths of a mile north of Moses Kill lock. This improvement is on the berme side and consists of strengthening eight chains of berme bank with embankment, and raising and lengthening parapet of culvert to hold the embankment.

12. This improvement is the original plan which has since been changed, vide No. 32 of this list.

13. At the foot of the Glens Falls feeder. This work is on the berme side and consists in widening three and one-half chains of the prism by excavating from the line of the feeder docking, north; also, to set back and rebuild the berme abutment, and construct a new road, and change bridge of eighty feet clear span.

14. Work on north side of lock 20. This work consists of changing ten chains of the present tow-path between lock 20 and present change bridge, from the west to the east side of the canal; also, changing present location of change bridge from a point eleven chains north of lock to a point about one chain north of lock, by constructing a new tow-path and berme abutment, and new superstructure for the change bridge at this point, and changing the present change bridge to a road bridge by constructing a new tow-path abutment and new superstructure. Some excavation is to be done on the tow-path, 210 feet of vertical wall in cement and sixty-six feet of slope wall to be constructed, connecting with the wall on the north side of the present bridge.

15. Rebuilding Eastman's waste-weir near Whitehall. This consists of rebuilding the waste-weir on an improved and enlarged plan with wrought iron lift gates and increased length of spillway.

16. Improving prism one mile south of Whitehall, widening thirteen and one-half chains of canal on berme side, and building berme abutment and new superstructure.

17. Improvement between bridges 139 and 140 at Whitehall. This consists of widening and straightening canal, and protecting the tow-path with slope wall from Sta. 0 to Sta. 41. No protection on the berme. Station 0 is just north of bridge 139.

18. Building bridge and abutments over escape to waste-weir No. 12. The highway crosses this stream and new abutments and superstructure are to replace the old ones.

19. Improving prism at R. R. bridge, north of lock 20. The canal is to be widened and straightened on tow-path, and berme sides from Sta. 0 to Sta. 11. Station o is four chains south of farm bridge. From Sta. 0 to Sta. 3 is to be protected by slope wall, and from Sta. 3 to Sta. 11 by vertical wall in cement. Berme has no protection.

20. Improving prism and building docking at Smith's basin. This improvement is on the berme side and consists of improving 262 feet of prism and banks from the bridge south.

21. Constructing seven bridge abutments. This work consists of tearing down and rebuilding the following abutments: . One tow-path abutment at Division street, Waterford; one tow-path abutment at second bridge north of lock No. 6; one tow-path and one berme abutment at second bridge south of lock No. 9; one berme abutment at first bridge north of Stillwater; one tow-path abutment at first bridge north of lock 14; one berme abutment at bridge 96, four miles south of Fort Edward.

22. Improvement south of Fort Miller lock. Six chains of canal is to be widened on the berme side, which widening consists of earth and rock excavation. Station 0=100 feet south of lower hollow quoin of lock No. 13.

23. Improvement at bridge No. 95. This consists of cutting off the rock projection in front of the berme abutment. This abutment was rebuilt and set back, and the rock was not excavated.

24. Strengthening leaking banks on the Glens Falls feeder, between Greene's bridge and Finch and Pruyn's mill. This work consists of repairing and pointing up vertical wall on both sides of the canal.

25. Rebuilding and widening the upper end of lock No. 10 on the Glens Falls feeder. This work consists of rebuilding the head of the lock on the enlargement plan.

26. Widening and straightening the sluices at the head of Fort Edward lock No. 15.

27. Additional appropriation for the completion of the Waterford work, No. 2 of this list.

28. Additional appropriation for the completion of Eastman's waste-weir, No. 15 of this list.

No. 29. Improvement at Sloop Lock pier, Troy dam. This work consists of building a timber crib filled with stone from the crest of the dam, south and east to the sloop lock; the crib to be built on the west side of old pier and at the elevation of the dam to lap over about eight feet on the pier of the lock.

30. Raising abutments and approaches, and rebuilding one tow-path abutment and two superstructures. This work consists of raising the abutments and approaches on the tow-path at first bridge north of Stillwater and at bridge No. 96, so as to give a clearance over the water of eleven feet for the bridge, setting back and rebuilding the tow-path abutment at the bridge at the mouth of the Glens Falls feeder, and building new superstructures for first bridge north of lock 14 and bridge No. 96.

31. Strengthening seven and one-third chains of the berme bank at Mechanicville. This work consists of rebuilding vertical wall in cement from the William street bridge south seven and one-third chains; also strengthening the berme bank with embankment, and protecting it at the foot of the bank at the culvert by means of a retaining wall about forty feet long. The waste-gate of the Hosiery Mill dam discharges directly opposite this bank and washes it away, and the wall is built to prevent this.

32. Improvement at Woodchuck Point. This work is according to

change of plan, and consists of widening the prism of the canal on tow-path and berme sides. From Station 0 to Station 4 the prism is to be widened on the berme, with no protection. From Station 4 to Station 11 the prism is to be widened on the tow-path side with a slope wall protection.

33. Improving eleven chains of canal between bridges 140 and 141. This work begins at a point eighty links north of bridge No. 140. Station 0 is Station 40+80 of No. 17 of this list, and is a continuation of No. 17 between bridges 139 and 140. This work is on both sides of the canal, the same being widened and straightened. On the tow-path from Station 0 to Station 8+50 a slope wall one and a quarter to one is to be built; from Station 8+50 to Station 10+50 a vertical wall in cement, and from Station 10+50 to 11 a twist wall connecting with old slope wall. The berme side to have no protection.

34. Improving eighteen chains of canal at the railroad bridge at Whitehall. This work is all on the tow-path, and begins at a point 4.38 chains south of the railroad bridge. From Station 0 to Station 18 the tow-path is to be straightened and protected by a vertical wall in cement. No protection on the berme.

35. Rebuilding culvert and improving three chains of canal at Thorne's lane, above Lock 6. This work consists of straightening three chains of tow-path, building a stone box diving culvert 3 + 4 feet, opening at right angles to the new inner angle and a short distance above the old structure; also building a new tow-path bank and straightening and deepening the ditch on the tow-path side.

36. Improvement at Coveville. This work consists of strengthening the bank by means of piles about twenty feet long driven close together at the foot of the slope and projecting when driven three feet above the surface of ground, and supporting one side of a pile of loose stone placed there to weight the bank; the content of this stone pile will be two cubic yards per running foot. Station 0 is 1.66 chains south of south end of crib built in repairing break of 1884, and runs as follows: Station 0 to Station 1+66; Station 3+30 to Station 5+30; Station 6 to Station 13+50; Station 14+30 to Station 17; making 13.86 chains, or 915 feet.

37. Improving eleven and one-half chains of the Glens Falls feeder at Finch & Pruyn's lime kiln, Glens Falls. The work to be done on the following plan: Commencing on the berme side about the center of Finch & Pruyn's warehouse, running thence west for a distance of about eleven and one-half chains to a projection in the vertical wall now standing. The old wall to be taken down and new vertical wall in cement built on a line about seven feet back of present wall, increasing the width of the prism.

38. Rebuilding waste-weir near Lock 20. The old foundation is to be repaired and used to support a structure with a spillway of eighty-four feet, having two waste gates two feet two inches by four feet. The plan of this work was designed to give sufficient strength to the structure to resist the action of ice and water in time of freshets; the masonry is to be clamped and bolted to make it strong and durable.

39. Balance needed to complete the work one mile south of Whitehall. No. 16 of this list.

Of the above pieces of work Nos. 3, 4, 5, 6, 7, 8, 13, 16, 17, 19, 21, 35, 36 and 38 are let and under contract; the balance will be done by the Superintendent of Public Works.

Of the above pieces of work done by the Superintendent of Public Works, Nos. 2, 10, 11, 15, 18, 20, 24, 25 and 29 are completed.

Of the above pieces of work under contract the following are now in progress of construction, and estimates for the accompanying amounts have been paid up to and including September 30, 1884:

No. 3.	For material delivered only; 15 per cent deducted.	$259 00
No. 5.	Fifteen per cent deducted	2,575 00
No. 6.	" " "	2,139 00
No. 8.	" " "	1,503 00
No. 16.	" " "	2,281 00
No. 17.	" " "	510 00
No. 19.	" " "	1,210 00
No. 21.	" " "	4,066 00

I would respectfully recommend that the following improvements be made, and the amounts set opposite each be appropriated by the Canal Board therefor, engineering expenses included in all estimates:

1. Between Lock 8 and the waste-weir on the berme side.

This improvement consists of strengthening the bank by means of sixty-six feet of vertical wall in cement, and by embankment between the head of the lock and the waste-weir.

Estimated cost.. $663 71

2. Two and one-half chains north of Wilbur's Basin waste-weir.

This improvement is on the tow-path side and runs from a point two chains fifty links north from the center of Wilbur's Basin waste-weir to a point nine and one-half chains north of the same, and consists of strengthening the bank by means of embankment.

Estimated cost.. 535 81

3. Between bridges Nos. 79 and 80.

This work is on the tow-path side and begins 11.36 chains north of the center of bridge No. 79 and ends at a point 4.82 chains south of bridge No. 80. This improvement consists of strengthening fifteen chains of bank with embankment.

Estimated cost.. 750 96

4. Between bridges Nos. 93 and 94, over culvert No. 14.

This improvement is on the berme side and consists of strengthening by embankment six chains of the bank. Station 2 + 60 is the center of culvert; stations run north.

Estimated cost.. 282 35

5. At Launder's culvert No. 15.

This improvement is on both sides of the canal. Station 6 + 21 is center of the culvert; stations run north. This consists of lengthening the berme end of the culvert thirteen feet and strengthening the berme bank by embankment from Station 3+33 to Station 8+33 and building slope wall from Station 4 to Station 8+33.

The tow-path to be strengthened by embankment from Station 1 to Station 11+50, from station 4 to Station 8+33, with vertical wall in cement; prism to have a width on bottom of forty-four feet.

Estimated cost.................................... $4,813 77

6. Between bridges Nos. 102 and 103.

This improvement is on the tow-path and begins at Station 0—40, six chains north of center of bridge No. 102, and runs thence northerly for a distance of 8.40 chains. The bank to be strengthened by embankment for the whole distance.

Estimated cost.................................... 601 33

7. Empie's waste weir No. 17, two and one-half miles south of Fort Ann.

This improvement is on the tow-path and consists of rebuilding the waste weir on an improved plan with wrought iron lift-gates.

Estimated cost.................................... 3,373 72

8. Between Broad and Division streets, Waterford.

This improvement is on the berme side and begins at the north end of the Broad street bridge and runs northerly about 250 feet, consisting of protecting the slope of the berme bank above the water level so as to give a six-foot passageway, by means of a slope wall on a batter of one-half to one, starting at C. B.+5.0, and the heighth to vary with the height of the old surface of ground; part of this wall to be laid in cement and part laid dry.

Estimated cost.................................... 627 09

Total.................................... $11,648 74

This amount, $11,648.74 deducted from $19,731.12 leaves $8,032.38, available for further improvements under the heading of extraordinary repairs.

By act, chapter 154 Laws of 1884, the Legislature appropriated the sum of $6,000 for the construction of an iron highway bridge over the Champlain canal in the town of Watervliet in the county of Albany. This work has been let by contract, and work on the same will begin the coming month.

ENGINEERING DEPARTMENT.

This division has for the past fiscal year been in charge of Charles A. Beach, division engineer from October 1, 1883, to January 2, 1884, and H. C. Parsons, resident engineer from October 1, 1883, to November 12, 1883; R. M. Hasbrouck, division engineer from January 4, to August

1, 1884; John R. Kaley, acting division engineer from August 1, to August 9, 1884, and John R. Kaley, division engineer from August 9, to October 1, 1884.

The work of the department has been attending to the general routine of office work, making surveys, plans and estimates for the various pieces of work mentioned in this report, where appropriations have been made and are recommended to be made for performing the same, amounting to more than forty pieces in all; locating, measuring and making report of the encroachments on the blue line of the Erie and Champlain canals; staking out and attending to the construction of bridges and abutments on the Erie canal; making surveys and plans for gravel pits on the Champlain canal and Glens Falls feeder. Locating, making plans and estimates for fishways in the dams on the Hudson river from Albany to Glens Falls; making surveys and plans for the Board of Claims, for property claimed to be damaged by leakage from the Erie canal at Port Schuyler and West Troy; also surveys, maps and estimates for claims for damages arising from the repairs to the Coveville break; staking out, superintending the construction and making monthly estimates of the work now under contract and of that being done by the Superintendent of Public Works. Establishing a line of much needed benches on the Champlain canal between Locks Nos. 8 and 9, Nos. 9 and 10 and Nos. 20 and 21; attending to the rebuilding and enlarging the upper end of Lock No. 10 on the Glens Falls feeder; building vertical wall in cement on the tow-path at Port Jackson and on the berme at Lock No. 30, Erie canal. A statement of the engineering expenses for this division is annexed, showing in detail the names of persons employed, time of service and compensation.

Statement showing names, rank, number of days and compensation of engineers employed on the eastern division of the New York State canals, together with incidental expenses during the fiscal year ending September 30, 1884.

ORDINARY REPAIRS — ERIE CANAL.

Chas. A. Beach, division engineer, salary $2,400	$408	76
Chas. A. Beach, division engineer, travel	88	64
R. M. Hasbrouck, division engineer, salary $2,400	918	78
R. M. Hasbrouck, division engineer, travel	13	56
John R. Kaley, division engineer, salary, $2,400	234	15
John R. Kaley, division engineer, travel	4	13
Henry C. Parsons, resident engineer, salary $2,000	157	08
John R. Kaley, asssistant engineer, 188 days at $5 per day	940	00
John R. Kaley, assistant engineer, travel	140	06
Geo. I. Bailey, rodman, 289 days at $3.50 per day.	1,011	50
Geo. I. Bailey, rodman, travel	122	57
F. W. Hodgman, rodman, 43 days at $3.50 per day.	150	50
F. W. Hodgman, rodman, travel	18	12
Martin Schenck, rodman, 26 days at $3.50 per day.	91	00
Martin Schenck, rodman, travel	21	11
Chas. H. Whitbeck, chainman, 230 days at $2.50 per day	575	00

Chas. H. Whitbeck, chainman, travel	$29 25	
John Donlan, chainman, 79 days at $2.50 per day.	197 50	
		$5,121 71

INCIDENTALS.

Fuel	$14 75	
Light	5 25	
Office rent	175 00	
Postage, telegraph and telephone	124 09	
Stationery	120 50	
Labor	98 00	
Miscellaneous	166 09	
		703 68
		$5,825 29

ORDINARY REPAIRS — CHAMPLAIN CANAL.

Chas. A. Beach, division engineer, salary $2,400.	$204 38	
Chas. A. Beach, division engineer, travel	48 50	
R. M. Hasbrouck, division engineer, salary $2,400	459 38	
R. M. Hasbrouck, division engineer, travel	20 65	
John R. Kaley, division engineer, salary $2,400	117 08	
John R. Kaley, division engineer, travel	27 36	
Henry C. Parsons, resident engineer, salary $2,000	78 54	
Henry C. Parsons, resident engineer, travel	27 15	
		$983 04
Total for Erie		5,825 39
Total for ordinary repairs		$6,808 43

EXTRAORDINARY REPAIRS — CHAMPLAIN CANAL.

Denison Richmond, engineer in charge, 36 days at $6 per day	$216 00
Denison Richmond, engineer in charge, travel	38 68
C. L. Johnson, assistant engineer, 194 days at $5 per day	970 00
C. L. Johnson, assistant engineer, travel	266 31
R. A. Hartwell, assistant engineer, 40 days at $5 per day	200 00
R. A. Hartwell, assistant engineer, travel	27 53
G. V. Rapp, assistant engineer, 26 days at $5 per day	130 00
G. V. Rapp, assistant engineer, travel	56 03
G. V. Rapp, leveller, 159 days at $4.50 per day	715 50
G. V. Rapp, leveller, travel	85 85
C. G. Douw, leveller, 96 days at $4.50 per day	432 00
C. G. Douw, leveller, travel	45 53
R. E. Morris, leveller, 127 days at $4.50 per day.	571 50

R. E. Morris, leveller, travel	$117 49	
Geo. I. Bailey, leveller, 26 days at $4.50 per day	117 00	
Geo. I. Bailey, leveller, travel	1 05	
C. R. Baldwin, rodmam, 194 days at $3.50 per day	679 00	
C. R. Baldwin, rodman, travel	85 75	
C. H. Barber, rodman, 185 days at $3.50 per day	647 50	
C. H. Barber, rodman, travel	44 50	
Thos. Murphy, rodman, 54 days at $3.50 per day	189 00	
Thos. Foley, rodman, 35 days at $3.50 per day	122 50	
Martin Schenck, rodman, 60 days at $3.50 per day	210 00	
Martin Schenck, rodman, travel	9 01	
Fred. W. Hodgman, rodman, 40 days at $3.50 per day	140 00	
Fred. W. Hodgman, rodman, travel	31 96	
F. D. Lamouree, rodman, 40 days at $3.50 per day	140 00	
F. D. Lamouree, rodman, travel	31 11	
F. D. Lamouree, chainman, 145 days at $2.50 per day	362 50	
F. D. Lamouree, chainman, travel	34 43	
Jno. T. Slattery, chainman, 61 days at $2.50 per day	152 50	
Jno. T. Slattery, chainman, travel	30 75	
John McElroy, chainman, 30 days at $2.50 per day	70 00	
John McElroy, chainman, travel	25 13	
		7,001 17

INCIDENTALS.

Stationery	$174 50	
Office rent	32 60	
Postage and telegraph	36 40	
Miscellaneous	311 00	
		554 50
Total		$7,555 67

The above table is summarized as follows:

Expended for ordinary repairs from October 1, 1883, to October 1, 1884, Erie canal	$5,121 71
Expended for ordinary repairs from October 1, 1883, to October 1, 1884, Champlain canal	983 04
Expended for incidentals, ordinary repairs, Erie and Champlain canals	703 68
Expended for extraordinary repairs from October 1, 1883, to October 1, 1884, Champlain canal	7,001 17
Expended for incidentals, extraordinary repairs form October 1, 1883, to October 1, 1884, Champlain canal	554 50
Total	$14,364 10

List of Benches from Lock No. 8 to No. 9, Champlain Canal.

Description.	Elevation above C. B.	Elevation above T. W.
Lower mitre-sill, lock No. 8	+0·000	+74·669
S. E. Hollow Quoin, lock No. 8	lower level. +19·975 upper level. +8·880	+94·644
Lower step, S. W. corner, tow-path abutment bridge No. 23	8·964	94·728
Lower step, S. W. corner, tow-path abutment bridge No. 24	10·865	96·629
Lower step, N. W. corner, tow-path abutment bridge No. 26	8·285	94·049
S. E. corner Hosiery mill, Mechanicville (water table)	10·351	96·115
Lower step, N. W. corner, tow-path abutment bridge No. 29	10·634	96·398
S. E. corner, north abutment waste-weir No. 3.	7·753	93·517
Lower step, N. E. corner, berme abutment bridge No. 30	10·440	96·204
Lower step, S. E. corner, abutment on tow-path of B., H. T. & W. R. R. bridge	7·743	93·507
Mitre-sill, lock No. 9	0·000	85·764

List of Benches on 16 Mile Level — Champlain Canal.

Established by C. L. Johnson, Assistant Engineer, between locks No. 9 and No. 10, May, 1884.

Description.	Elevation above C. B.	Elevation above T. W.
Lower mitre-sill, lock No. 9 (starting point).	+0·000	+85·764
S. E. gate anchor, lock No. 9	lower level. +17·073 upper level. +8·776	+102·837
S. E. corner, lower step, berme abutment bridge No. 32	12·691	106·752
Water line, berme abutment bridge No. 32.	7·299	101·360
N. E. corner, lower step, berme abutment bridge No. 33	8·642	102·703
S. E. corner, 3d step from top, berme abutment bridge No. 34	14·976	109·037
Lansing's waste-wier coping, S. end, east stone	9·213	103·274
Lansing's waste-weir coping, N. end, east stone	9·011	103·072
S. W. corner, lower step, tow-path abutment bridge No. 38	9·765	103·826
Second course, third stone from S. end, tow-path abutment Stratton's bridge No. 39.	9·579	103·640
N. E. corner, lower step, berme abutment Baker's bridge No. 42	11·912	105·973

Description.	Elevation above C. B.	Elevation above T. W.
S. E. corner, middle abutment, Bemis Hights waste-weir	+9·934	+103·995
N. E. corner, second step from bottom, berme abutment Cheever's bridge No. 46	10·947	105·008
N. E. corner coping, S. end, Wilbur's waste-weir	8·473	102·534
S. E. corner coping, N. end, waste-weir No. 7.	9·807	103·868
N. E. corner, second step from bottom, berme abutment Holmes' bridge No. 59	13·032	107·093
N. E. corner coping, S. end Coveville waste-weir	9·140	103·201
Point on stone, second course, S. end, tow-path abutment Wilcox bridge No. 62	11·047	105·108
Elm tree, 150 feet S. of Cramer's bridge No. 63, tow-path side	9·113	103·174
Ash tree, near Sta. 43 (Coveville Improvement Survey)	10·031	104·092
N. W. corner, lower step, tow-path abutment Slade's bridge No. 64	13·760	107·821
Point on second stone from S. end, tow-path abutment Cramer's bridge No. 65	9·773	103·834
Top of spillway, Fish Creek Aqueduct (East side)	7·962	102·023
Bottom of Fish Creek Aqueduct	−0·158	93·903
Second step from bottom N. W. wing wall, tow-path abutment Ferry St. (Schuylerville), bridge No. 68	+12·648	106·709
S. W. corner, lower step, tow-path abutment Saratoga St. (Schuylerville), bridge No. 69.	12·468	106·529
N. W. corner, second step from bottom, tow-path abutment Bullard's bridge No. 70	13·656	107·717
Mitre-sill, lock No. 10	0·000	94·061

Elevation of mitre-sill, lock No. 10. 94·061
Elevation of lower mitre-sill, lock No. 9........................ 85·764

Lift of lock No. 9................ 8·297

BENCH MARKS ON WHITEHALL LEVEL, BETWEEN LOCKS NOS. 20 AND 21.

Description.	Elevation above C. B.	Elevation above T. W.
On coping N. E. gate, anchor lock No. 20.	+12.987 upper level. +13.025 lower level.	+128.235
Berme abutment, north end, N. E. corner 4th course down, bridge No. 135	+13·150	128·360
Berme abutment, north end, N. E. corner 6th course down, bridge No. 136	10·617	125·827

Description.	Elevation above C. B.	Elevation above T. W.
Berme abutment, south end, S. E. corner 5th course down, bridge No. 137	+11·625	+126·835
Berme abutment, south end, S. E. corner 6th course down, bridge No. 138	11·083	126·293
Tow-path abutment, north end, N. W. corner 7th course down, bridge No. 139	10·316	125·526
Tow-path bent, north end, N. W. corner bridge No. 140	8·108	123·318
Tow-path abutment, north end, N. W. corner 6th course down, bridge No. 141	12·341	127·551
Tow-path abutment, north end, N. W. corner 8th course down, bridge No. 142	9·221	124·431
Berme abutment, north end, N. E. corner 4th course down, bridge No. 143	11·346	126·556
Berme abutment, south end, S. E. corner 5th course down, bridge No. 144	10.348	125·558
Tow-path bent, north end, N. W. corner, bridge No. 145	8·979	124·189
Tow-path abutment, north end, N. W. corner 7th course down, bridge No. 146	9·155	124·365
North end of wing, north end corner lower course, R. R. bridge	8·899	124·109
Tow-path abutment, north end, N. W. corner 6th course down, bridge No. 147	10·155	125·365
Tow-path bent, north end, N. W. corner, foot bridge	8·395	123·605
Tow-path abutment, south end, S. W. corner lowest course, iron R. R. bridge	10·658	125·868
Tow-path abutment, north end, N. W. corner 7th course down, R. R. bridge No. 148	11·061	126·271
Tow-path bent, north end, N. W. horse bdg.	9·034	124·244
On coping N.E.E. gate, anchor lock No. 21.	7·600	122·810

All benches marked thus, ⊗.

EASTERN DIVISION — ERIE CANAL.

List of benches showing elevation canal bottom and above tide-water. T. W. = mean low tide, as determined by Captain Willard, U. S. Engineers Corps.

No.	Description.	Elevation above C. B.	Elevation above T. W.
1.	On shelf at lower end of pier, between locks at lock 1, marked ⊗, with chisel.	....	+9·486
2.	Lower miter-sill, lock No. 1	+0·000	−7·443
3.	The coping of weigh lock	9·55	....
4.	At station 53½, on tow-path abutment, Ferry street bridge on the north stone lower course, marked O, with chisel..	9·524	17.240
5.	At station 82¾, on tow-path tower of Suspension foot bridge, on projection of south cross-sill, marked ⊗ with knife.	10·426	18·142

No.	Description.	Elevation above C. B.	Elevation above T. W.
6.	Lower mitre-sill, lock No. 2 (at heel of S. W. gate, W. lock)................	+0·000	+7·716
7.	At station 0, on coping of lock No. 2, between ends of anchor of S. W. gate of W. lock marked ⊗ — B. M. with chisel..........................	18·000 lower level. +8·505 upper level.	25·716
8.	At station 39 on N., and tow-path parapet of culvert, marked ⊗ — B. M. with chisel............................	+7·226	24·437
9.	At station 97½ on N., and tow-path parapet of culvert, marked ⊗ — B. M. with chisel............................	7·923	25·134
10.	At station 156 on S. E. corner of coping on retaining wall of bridge approach, marked ⊗, with chisel...............	10·353	27·564
11.	At station 166, on N. E. corner tow-path, parapet of culvert, marked ⊗, with chisel............................	8·486	25·697
12.	At station 189, on coping of retaining wall at S. end of tow-path parapet of culvert, marked ⊗ —B. M. with chisel.	8·066	25·277
13.	At station 217, on N. end of retaining wall to bridge approach, N. E. corner of coping, marked ⊗ — B. M. with chisel....................	10·406	27·417
14.	At station 243¾, N. E. corner N. wing of tow-path abutment on coping marked ⊗ and on face of coping B. M. with chisel............................	14·574	31·785
15.	At station 269, on coping of lock on "lower side cut," at anchor of N. W. gate, marked ⊗—B. M. with chisel...	8·584	25·795
16.	At station 290, on tow-path abutment of Arsenal bridge at N. angle of main wall, top of lower course, marked ⊗ and (above) B. M. with chisel.......	11·566	28·777
17.	At station 320, on tow-path abutment of Ferry street bridge, S. E. corner of lower step of wing, marked ⊗ with chisel and (on face of stone) B. M....	11·563	28·774
18.	At station 365, on coping of N. wall, north lock of upper side cut, N. W. corner of W. stone, marked ⊗—B. M. with chisel.........	9·257	26·468
19.	At station 398½, on N. E. corner tow-path parapet of culvert, marked ⊗—B. M. with chisel......................	8·480	25·691
20.	Lower mitre-sill of Lock No. 3, at heel of S. W. gate of W. lock...............	0·000	17·211

No.	Description.	Elevation above C. B.	Elevation above T. W.
21.	On coping of lock No. 3, between ends of anchor S. W. gate of W. lock, marked ⊗— B.M. with chisel......	+20·260 lower level. +9·091 upper level.	+37·471
22.	Lower mitre-sill of lock 4 (at heel of S. W. gate, W. lock)..................	+0·000	28·380
23.	On coping of lock No. 4, between ends of anchor, S. W. gate, W. lock, marked ⊗—B. M. with chisel.....	20·220 lower level. +8·840 upper level.	48·600
24.	Lower mitre-sill, lock No. 5, at heel of S. E. gate, E. lock.	+0·000	39·760
25.	On coping of lock No. 5, between ends of anchor S. E. gate, E. lock, marked ⊗—B. M. with chisel...............	19·630 lower level. +9·033 upper level.	59·390
26.	Lower mitre-sill, lock No. 6, at heel of S. W. gate of W. lock	+0·000	50·357
27.	On coping of lock No. 6, between ends of anchor S. W. gate, W. lock, marked ⊗—B. M. with chisel.............	19·000 lower level. +8·927 upper level.	69·357
28.	Lower mitre-sill of lock No. 7, at heel of S. E. gate, E. lock...................	+0·000	60·430
29.	On coping, lock No. 7, between ends anchor, S. E. gate, E. lock, marked ⊗—B. M. with chisel	18·580 lower level. +8·649 upper level.	79·010
30.	Lower mitre-sill, lock No. 8, at heel of S. W. gate, W. lock	+0·000	70·361
31.	On coping, lock No. 8, between ends of anchor, S. W. gate, W. lock, marked ⊗—B. M. with chisel.............	18·885 lower level. +8·340 upper level.	89·246
32.	Lower mitre-sill, lock No. 9, at heel of S. E. gate, E. lock	+0·000	80·906
33.	On coping, lock No. 9, between ends of anchor, S. E. gate, E. lock, marked ⊗—B. M. with chisel.............	18·500 lower level. +9·092 upper level.	99·406
34.	Lower mitre-sill, lock No. 10, at heel of S. W. gate, W. lock	+0·000	90·314
35.	On coping, lock No. 10, between ends of anchor, S. W. gate, lock W., marked ⊗—B. M. with chisel.....	19·000 lower level. +8·638 upper level.	109·314
36.	Lower mitre-sill, lock No. 11, at heel of S. W. gate, W. lock.................	+0·000	100·676
37.	On coping, lock No. 11, between ends of anchor, S. W. gate, W. lock, marked ⊗—B. M. with chisel......	18·650 lower level. +9·029 upper level.	119·326

No.	Description.	Elevation above C. B.	Elevation above T. W.
38.	Lower mitre-sill, lock No. 12, at heel of S. W. gate, W. lock..................	+0·000	+110·297
39.	On coping, lock No. 12, between ends of anchor, S. W. gate, W. lock, marked ⊗—B. M. with chisel........	19·090 lower level. +9·194 upper level.	129·387
40.	Lower mitre-sill, lock No. 13, at heel of S. E. gate, E. lock..................	+ 0·000	120·193
41.	On coping, lock No. 13, between ends of anchor, S. E. gate, E. lock, marked ⊗—B. M. with chisel......	19·100 lower level. +8·745 upper level.	139·293
42.	Lower mitre-sill, lock No. 14, at heel of S. E. gate, E. lock..................	+0·000	130·548
43.	On coping, lock No. 14, between ends of anchor, S. E. gate, E. lock, marked ⊗—B. M. with chisel..............	18·700 lower level. +8·668 upper level.	149·248
44.	Lower mitre-sill, lock No. 15, at heel of S. E. gate, E. lock..................	+0·000	140·580
45.	On coping, lock No. 15, between ends of anchor, S. E. gate, E. lock, marked ⊗—B. M. with chisel............	18·800 lower level. +8·967 upper level.	159·380
46.	Lower mitre-sill, lock No. 16, at heel of S. E. gate, E. lock....................	+0·000	150·413
47.	On coping, lock No. 16, between ends of anchor, S. E. gate, E. lock, marked ⊗—B. M. with chisel.............	18·920 lower level. +8·875 upper level.	169·333
48.	Lower mitre-sill, lock No. 17, at heel of S. W. gate, W. lock..................	+0·000	160·458
49.	On coping, lock No. 17, between ends of anchor, S. W. gate, W. lock, marked ⊗—B. M. with chisel......	19·020 lower level. +8·733 upper level.	179·478
50.	Lower mitre-sill, lock No. 18, at heel of S. W. gate, W. lock..................	+0·000	170·745
51.	On coping, lock No. 18, between ends of anchor, S. W. gate, W. lock, marked ⊗—B. M. with chisel.....	19·040 lower level. +8·791 upper level.	189·785
52.	At station 18 1-4, on coping of south abutment of waste-weir on tow-path, marked ⊗—B. M. with chisel........	9·035	190·029
53.	At station 57 1-2, on N. end, berme abutment (wing) of bridge, marked ⊗—B. M. with chisel.....................	10·156	191·150
54.	At station 128 1-2, S. E. corner coping, N. wing berme abutment of farm bridge, marked ⊗—B. M. with chisel.	15·526	196·520

No.	Description.	Elevation above C. B.	Elevation above T. W.
55.	At station 129 1-2, on N. end tow-path abutment of farm bridge, on projection of fifth stone from top at N. end of wing, marked ⊗ and on stone above, B. M. with chisel..................	+12·024	+193·018
57.	At station 168 3-4, on top of coping of S. wing, at end tow-path abutment of farm bridge, marked ⊗—B. M. with chisel...........................	11·143	192·137
58.	At station 169 1-4, on top of coping of N. wing, at end berme abutment of farm bridge, marked ⊗—B. M. with chisel...........................	11·461	192·455
59.	At station 220 1-4, on top of coping, S. W. corner S. E. wing of aqueduct, marked ⊗—B. M. with chisel........	13·308	194·302
60.	At station 238, on top of coping, N. W. corner N. W. wing of acqueduct, marked ⊗—B. M. with chisel.......	13·189	194·183
61.	At station 340, on projection on face of first stone under coping, east wing tow-path abutment, marked ⊗—B. M. with a chisel......................	11·552	192·546
62.	At station 340, at centre of tow-path abutment on face of sixth course under coping, marked B. M.—⊗ with chisel.	10·176	191·170
64.	At station 432 1-2, on projection on sixth course below coping, near centre tow-path abutment, marked B. M.—⊗ with chisel.......................	9·949	190·943
65.	At station 461, on rock at rear of tow-path, marked ⊗—B. M.............	11·158	192·152
66.	At station 512 1-4, on projection on sixth course below coping, near W. angle face of tow-path abutment (Clute's), road bridge, marked ⊗—B. M. with chisel............................	11·079	192·073
67.	At station 521 1-2, of face of E. wing tow-path abutment of first bridge W. of Clute's dry dock, end stone, second course below coping, marked ⊗—B. M. with chisel.......................	11·294	192·288
68.	At station 543, on face of tow-path abutment, second bridge W. of Clute's dry dock, sixth course below coping near E. angle, marked ⊗—B. M with chisel.	10·900	191·894
69.	At station 568, on face tow-path abutment, third bridge W. of Clute's dry dock, fifth course below coping near W. angle, marked ⊗—B. M. with chisel	10·959	191·953

No.	Description.	Elevation above C. B.	Elevation above T. W.
70.	At station 598 1-2, on face tow-path abutment, road bridge at Whitehead's dock, on sixth course below coping near centre of abutment, marked B. M.—⊗ with chisel........................	+9·529	+190·523
71.	At station 633 3-4, on face tow-path abutment of farm bridge, near centre on projection of footing course, sixth below coping, marked B. M.—⊗.......	8·163	189·157
72.	At station 658 1-2, on face tow-path abutment of second bridge E. of lock 19 on projection on fifth course below coping near E. angle, marked ⊗—B. M. with chisel.....................	9·710	190·704
73.	At station 693 1-4, on top of E. corner, first stone under coping, E. wing of tow-path abutment of first bridge E. of lock 19, marked ⊗ (on top) B. M. (on face) with chisel................	11·753	192·747
74.	Lower mitre-sill, lock No. 19, at heel of N. E. gate of S. lock (pier wall).....	0· 000	180·994
75.	On coping lock No. 19 near ends of anchor, N. E. gate, S. lock (pier wall) marked ⊗—B. M. with chisel.	17·22 lower level. 8·779 upper level.	198·214
76.	At station 70, on N. corner of coping, at end of W. wing of tow-path abutment, road bridge at Vischer's Ferry, marked (on top) ⊗ and (on face) ⊗—B. M. with chisel..................	12·119	201·554
77.	At station 140, on rock, cut on rock at rear of tow-path, marked B. M. ⊗ with chisel.........................	10.713	200·148
79.	Lower mitre-sill, lock No. 20 at heel of N. E. gate, N. lock................	0·000	189·435
80.	On coping lock No. 20, at ends of anchor, N. E. gate N. lock, marked ⊗—B. M with chisel.............	18·660 lower level. 8·242 upper level.	208·095
81.	At station 108½, above lock 20 on top of coping at E. end of wing berme abutment, road bridge at Fonda's basin marked ⊗ and (on face) B. M. with chisel	12·170	212·563
82.	Lower mitre-sill, lock No. 21, at heel of S. E. gate, S. lock	0·000	199·853
83.	On coping, lock No. 21, at ends of anchor, S. E. gate, S. lock, marked ⊗—B. M. with chisel............	19·720 lower level. +8·594 upper level.	219·573

No.	Description.	Elevation above C. B.	Elevation below T. W.
84.	Lower mitre-sill, lock No. 22, at heel of N. E. gate, N. lock................	+0·000	+210·979
85.	On coping lock No. 22, near ends of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel.	20·180 lower level. 8·571 upper level.	231·159
86.	At station 6¼ on N. E. corner of coping on end of tow-path wing, N. end of upper Mohawk aqueduct, marked ⊗ and on face of stone, B. M. with chisel.	9·418	232·009
87.	At station 16, on top dowell in coping, near end of parapet, tow-path wing, south end of aqueduct ⊗, and on stone near it ⊗—B. M. with chisel........	13·089	235·677
88.	At station 24¼, on north wing of berme abutment of first road bridge west of aqueduct, top of coping marked ⊗, and on face of stone, B. M. with chisel...	12·928	235·516
89.	At station 143, on face of tow-path abutment, Vedder's bridge, projection on lower course near W. angle marked ⊗, and on stone above, B. M. with chisel.	8·556	231·144
90.	At station 161¼, on face of tow-path abutment of farm bridge near centre projection of sixth course under coping, marked B. M.—⊗ with chisel........	10·673	233·261
91.	Station 210, on face of tow-path abutment of R. R. bridge on stone near W. end about 2½ in. above joint marked B. M.—⊗ with chisel...............	11·031	233·619
92.	Station 230¼, on top of coping on end of W. wing berme abutment of road bridge, marked ⊗—B. M. (on top of coping) with chisel.................	10·208	232·796
93.	Station 264, on top of coping on end of E. wing of tow-path abutment of road bridge, marked ⊗, and on face of stone B. M. with chisel..................	11·783	234·371
94.	Station 284. On top of coping on end of E. wing of berme abutment of Front street bridge marked ⊗, and on face of stone B. M. with chisel.............	10·189	232·777
95.	Station 311, on S. W. corner of coping of retaining wall E. of street bridge, marked ⊗, and on face of stone B. M. with chisel.......................	13·695	236·283
96.	Station 337, on third step from bottom at E. end of tow-path abutment, State street bridge, marked ⊗, and on end of step B. M. with chisel................	12·014	234·602

No.	Description.	Elevation above C. B.	Elevation above T. W.
97.	Station 368 1-2, on top of coping, S. W. corner of parapet of waste-weir, marked ⊗, and (on face) B. M. with chisel...	+11·630	+234·218
98.	Station 504 1-2, near centre of face of tow-path abutment of bridge at Navanier's bay on projection of sixth course below coping, marked ⊗, and on stone above B. M. with chisel....................	9·324	231·912
99.	Lower mitre-sill of lock No. 23, at heel of N. E. gate, N. lock..............	0·000	222·588
100.	On top of coping, lock No. 23, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel......	16·900 lower level. 8·582 upper level.	239·488
101.	Station 9, on face of tow-path abutment of farm bridge, near W. angle on projection of sixth course below coping, marked ⊗, and on stone above B. M. with chisel	9·115	240·021
102.	Lower mitre-sill of lock No. 24, at heel of N. E. gate, N. lock..............	0·000	230·906
103.	On coping of lock No. 24, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel......... ...	16·860 lower level. 9·534 upper level.	247·766
104.	Station 49 3-4, on face of tow-path abutment of road bridge, on projection on course below coping, marked ⊗, and on stone above B. M. with chisel........	12·402	250·634
105.	Station 99 1-4, on face of tow-path abutment of farm bridge, on projection on sixth course below coping, near E. angle, marked B. M.—⊗ (on the stone) with chisel	10·885	249·117
106.	Station 113+88, on E. end of Flat Stone Creek aqueduct, tow-path side abutment, six inches east of junction of wing and straight wall at foot of parapet, marked ⊗, and (on face of coping of parapet above it) B. M. with chisel.	10·068	248·300
107.	Station 181 1-2, near centre of face of tow-path abutment of road bridge, on projection of sixth course below coping, marked B. M.—⊗, with chisel.......	12·237	250·469
108.	Station 218, near W. angle face of tow-path abutment of farm bridge, on projection of seventh course below coping, marked ⊗, and on stone above B. M. with chisel	11·462	249·694
109.	Station 294 1-2, at centre of face of tow-path abutment, first bridge below lock		

No.	Description.	Elevation above C. B.	Elevation above T. W.
	No. 25, on projection of footing course (seventh below coping), marked ⊗, and on stone above B. M. with chisel.....	+9·740	+247·972
110.	Lower mitre-sill of lock No. 25, at heel of N. E. gate, N. lock, marked ⊗....	0·000	238·232
111.	On coping of lock 25, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel......................	17·530 lower level. 8·949 upper level.	255·762
112.	Station 40 1-2, on corner of coping, end of W. wing tow-path abutment of farm bridge, marked ⊗ (on top) and B. M. (on face) with chisel................	11·531	258·344
113.	Station 74, on face tow-path abutment of farm bridge (near W. angle), on projection of fourth course below coping, marked ⊗, and on stone above, B. M. with chisel.................	12·321	259·134
114.	Station 118, on coping end of W. wing berme abutment of road bridge, marked ⊗—B. M. with chisel..............	11·530	258·343
115.	Station 171, on coping of parapet Sansai Kill Aqueduct, at E. angle (junction of wing with straight wall), marked ⊗—B. M. with chisel...............	12·650	259·463
116.	Station 253+80, on small granite boulder rear of tow-path (is about fifty feet east of line of stone fence between orchard and corn field on hill across canal), marked ⊗— B. M. with chisel......	8·386	255·199
117.	Station 285 1-2, on flat white rock at N. angle of tow-path, opposite the middle of the bay, below lower end of rocky bluff on berme, marked ⊗—B. M. with chisel.	8·747	255·560
118.	Station 347, on flat sand stone at rear tow-path and at west end of first course below Swart's bridge, marked ⊗—B. M. with chisel.....................	8·223	255·036
119.	Station 360 3-4, on parapet of culvert (berme side) of N. W. corner of coping, marked ⊗—B. M. with chisel	1·240	248·053
120.	Station 398 1-2, on top of stone under coping on E. wing of tow-path abutment of Klein's bridge, marked ⊗ (on face) and B. M. with chisel.........	12·485	259·298
121.	Station 460, on coping E. wing tow-path abutment of farm bridge, marked ⊗, and on face, B. M. with chisel....	12·492	259·305
122.	Lower mitre-sill, lock No. 26, at heel of N. E. gate, N. lock, marked ⊗—B. M.	0·000	246·813

No.	Description.	Elevation. above C. B.	Elevation above T. W.
123.	On coping lock No. 26, at end of anchor N. E. gate, N. lock, marked ⊗—B. M. with chisel................	+16·870 lower level. 8·505 upper level.	+263·683
124.	Lower mitre-sill, lock No. 27, at heel of N. E. gate, N. lock................	0·000	255·178
125.	On coping of lock No. 27, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel....	16·430 lower level. 8·544 upper level.	271·608
126.	Station 61 1-2, on retaining wall over berme end of culvert, five inches west of centre line, marked ⊗, with chisel...	3·379	266·543
127.	Station 96 1-2, on tow-path end of culvert at top of sloping coping, E. corner of second stone from E. side, marked ⊗—B. M. with chisel........	2·109	265·273
128.	Station 163 3-4, on coping of waste-weir near N. W. corner of top of E. wall, marked ⊗—B. M. with chisel.......	8·723	271·887
129.	Station 203 1-2, on top of lower step at W. end tow-path abutment of street bridge (east bridge at Port Jackson), marked ⊗—B. M. with chisel.......	16·281	279·445
130.	Station 225 1-4, on top of coping at centre pier of Port Jackson creek culvert (T. P. side), marked ⊗, and (on slope) B. M. with chisel.................	0·727	263·891
131.	Lower mitre-sill, lock No. 28, at heel of S. E. gate, E. lock, marked ⊗—B. M.	0·000	263·164
132.	On top of coping lock No. 28, at end of anchor, S. E. gate, S. lock, marked ⊗—B. M. with chisel............	16·870 lower level. 9·147 upper level.	250 034
133.	Station 85¾, at E. end of tow-path abutment farm bridge on top of 3d stone above ground, marked ⊗ and (on face) B. M. with chisel..................	12·260	283·147
134.	Station 138, on centre face of tow-path abutment farm bridge, on projection of 6th stone below coping, marked ⊗—B. M. with chisel..................	11·717	282·604
135.	Lower mitre-sill, lock No. 29, at heel of N. E. gate, N. lock..............	0·000	270·887
136.	On coping lock No. 29, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel	16·520 lower level. 9·121 upper level.	287·407
137.	Station 30, on face of tow-path abutment of farm bridge, on projection of		

No.	Description.	Elevation above C. B.	Elevation above T. W.
	4th stone below coping, near E. angle, marked ⊗—B. M. with chisel	+12·491	+290·777
138.	Lower mitre-sill, lock No. 30, at heel of N. E. gate, N. lock	0.000	278·286
139.	On coping lock No. 30, at end of anchor, N. E. gate, N. lock, marked	19·370 lower level. 9·157 upper level.	297·656
140.	Station 18¾, at foot of parapet, at end of W. wing, tow-path side of Schoharie creek aqueduct, marked ⊗ and on parapet above B. M. with chisel	10·205	298·704
142.	Station 123½, top of lower step W. wing, berme abutment of farm bridge, marked ⊗, and B. M. (on end of stone) with chisel	13·411	301·910
143.	Station 152¼, on face of tow-path abutment, near E. angle on projection of 5th course below coping marked ⊗, and (on stone above) B. M. with chisel	11·899	300·398
144.	Station 181½, on face of tow-path abutment of farm bridge on projection of 6th course below coping, near W. angle, marked ⊗, and (on stone above) B. M. with chisel	11·595	300·094
145.	Station 253½, on face of tow-path abutment of farm bridge near E. angle on projection of 5th course below coping, marked ⊗, and (on stone above) B. M. with chisel	11·474	300·883
146.	Station 281, on face of tow-path abutment of covered road bridge near W. angle of projection of 4th stone below coping, marked ⊗, and (on stone above) B. M with chisel	12·070	300·569
147.	Station 306¼, top of lower step of W. wing berme abutment of farm bridge, marked ⊗—B. M. with chisel	13·485	301·984
148.	Station 345¼, on top of lower step, E. wing berme abutment of farm bridge, marked ⊗ with chisel	11·928	300·427
149.	Station 394, on top of lower step, W. wing of berme abutment marked ⊗ with chisel	11·331	299·830
150.	Station 482½, on top of coping at end of E. wing of tow-path abutment of farm bridge, marked ⊗, and (on face of stone) B. M. with chisel	12·717	301·216
151.	Station 539, on face of tow-path abutment of farm bridge, near E. angle on		

No.	Description.	Elevation above C. B.	Elevation above T. W.
	projection of 4th course below coping, marked ⊗—B. M. with chisel	+11·359	+299·849
152.	Station 613, on face of top stone, end of W. wing, tow-path abutment of farm bridge on projection of stone, marked ⊗—B. M. with chisel	11·896	300·395
153.	Station 664 3-4, on top of coping at end of E. wing of Tokkon Creek aqueduct, tow-path side, marked ⊗—B. M. with chisel	8·024	296·523
154.	Station 737, on face of tow-path abutment of farm bridge, near E. angle on projection of fourth stone below coping, marked ⊗—B. M. with chisel	10·856	299·355
155.	Station 813 1-2, on top of second stone below coping, at end of E. wing of berme abutment of farm bridge at Yatesville, marked ⊗ and (on stone above) B. M. with chisel	10·594	299·093
156.	Station 846 1-4, on top of coping, N. E. corner, N. E. wing of Leonardson's Creek aqueduct, marked ⊗—B. M. with chisel	8·122	296·621
157.	Station 935, on top of coping of E. abutment of aqueduct, N. W. corner (tow-path side) of main wall, marked ⊗—B. M. with chisel	7·979	296·478
158.	Station 1,079 1-2, on top of lower step, W. wing, berme abutment of farm bridge, marked ⊗—B. M. with chisel.	12·336	300·835
159.	Lower mitre-sill of lock No. 31, at heel of N. E. gate, S. lock (on pier side)	0·000	288·499
160.	On coping, lock 31, at end of anchor, N. E. gate, S. lock (pier wall) marked ⊗—B. M. with chisel	14·760 lower level. 8·893 upper level.	303·259
161.	Station 17 1-2, on face of tow-path abutment, Ferry street bridge, on projection of fifth course below coping (near centre, old bench), marked ⊗—B. M. with chisel	10·392	304·758
162.	Station 49 1-4, on face, tow-path abutment of farm bridge, projection on fifth course below coping, near W. angle, marked ⊗—B. M. with chisel	11·325	305·691
163.	Station 82 3-4, on face of tow-path abutment of farm bridge, projection of sixth course below coping, near centre, marked B. M.—⊗, with chisel	9·990	304·356
164.	Station 142 1-3, on face of tow-path abutment of farm bridge, on projection		

No.	Description.	Elevation above C. B.	Elevation above T. W.
	of seventh course below coping, near W. angle, marked ⊗ — B. M. with chisel..............	+8·824	+303·190
165.	Station 205 3-4, on face tow-path abutment of farm bridge, on projection of fourth course under coping (near centre), marked B. M.—⊗.............	9·873	304·239
166.	Station 252, on top of coping of parapet at N. E. wing of Plattkill aqueduct (N. E. corner of end stone), marked ⊗, and on face B. M. with chisel. ...	13·194	307·560
167.	Station 314, on top of coping at end of E. wing, tow-path abutment of farm bridge, marked ⊗, and (on face) B. M. with chisel.........................	12·412	306·778
168.	Station 370 1-2, on rear upper corner of first stone under coping at end of W. wing, berme abutment of farm bridge, marked B. M.—⊗ with chisel........	11·150	305·516
169.	Station 475 1-4, on tow-path abutment of farm bridge, near centre of face of E. wing, projection on second stone above ground, marked B. M.—⊗ with chisel.............................	10·689	305·055
170.	Lower mitre-sill, lock No. 32 (at heel of N. E. gate, N. lock)................	0·000	294·366
171.	On coping lock 32, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel..................	lower level. 17·110 upper level. 8·984	311·476
172.	Station 27 3-4, on front corner, third step from bottom on E. wing tow-path abutment, iron street bridge, marked ⊗ (and on end of stone), B. M. with chisel.	11·905	314·397
173.	Station 60, on top coping at end of W. wing tow-path abutment, farm bridge, marked ⊗, and on face, B. M. with chisel.............................	11·145	313·637
174.	Station 90, on face of tow-path abutment of farm bridge (near centre) projection of sixth course below coping, marked ⊗ and (on stone above), B. M. with chisel.............................	9·420	311·912
175.	Station 122, on coping of parapet, tow-path end of culvert at centre, marked B. M.—⊗, with chisel.............	4·461	306·953
176.	Station 314 3-4, on corner of coping, E. wing wall of culvert, marked ⊗—B. M. with chisel.....................	6·712	309·204
177.	Station 337, on face tow-path abutment of farm bridge at W. angle projection		

No.	Description.	Elevation above C. B.	Elevation above T. W.
	on 6th course below coping, marked B. M.—⊗ with chisel..............	+10·353	+312·845
178.	Lower mitre-sill, lock No. 33, at heel of N. E. gate, N. lock.................	0·000	302·492
179.	On coping lock No. 33 at end of anchor of N. E. gate, N. lock, marked ⊗—B. M. with chisel............	14·770 lower level. 9·066 upper level.	317·262
180.	Station 29¼, on coping of tow-path parapet of culvert (near centre), marked ⊗—B. M. with chisel.................	2·414	310.610
181.	Station 65¾, on lower step, E. wing tow-path abutment of road bridge marked ⊗, and on face B. M. with chisel....	13·439	321·635
182.	Station 175¾, on face tow-path abutment of farm bridge near E. angle projection on fifth course below coping, marked ⊗—B. M. with chisel.......	11·421	319·617
183.	Lower mitre-sill, Lock No. 34 at heel of N. E. gate, N. lock	0·000	308·196
184.	On coping lock No. 34, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel	17·080 lower level. 8·597 upper level.	325·276
185.	Station 45½, on face of tow-path abutment of farm bridge near W. angle projection of 7th course below coping, marked B. M.—⊗ with chisel.......	8·774	325·453
186.	Station 94, on face of tow-path abutment of road bridge (E. creek landing) near centre projection of 7th course below coping, marked ⊗, and (on stone above) B. M. with chisel............	10·912	327·591
187.	Station 174 1-4, on face of tow-path abutment of farm bridge, near W. angle projection of seventh course below coping, marked ⊗,and(on stone above) B. M. with chisel...................	9·829	325·598
188.	Station 217 1-2, on face of tow-path abutment of farm bridge, near centre projection of seventh course below coping, marked ⊗—B. M. with chisel.	9·619	326·298
189.	Lower mitre-sill, lock No. 35, at heel of N. E. gate, N. lock	0·000	316·679
190.	On coping, lock No. 35, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel.............	16·850 lower level. 9·065 upper level.	333·529
191.	Station 35, at centre of face, W. wing, tow-path abutment, third course above ground, marked ⊗—B. M. with chisel.	11·233	335·697

No.	Description.	Elevation above C. B.	Elevation above T. W.
192.	Station 71, on top of coping, E. wing, berme abutment of farm bridge, marked ⊗—B. M. with chisel	+13·826	+338·290
193.	Station 216 1-4, on top of coping, E. wing, tow-path abutment of farm bridge, marked ⊗, and (on face) B. M. with chisel	12·053	336·517
195.	Lower mitre-sill of lock No. 36, at heel of N. E. gate, N. lock	0·000	324·464
196.	On top of coping, lock No. 36 (at E. end of hollow quoin stone), N. E. gate, N. lock, marked ⊗—B. M. with chisel	18·780 lower level. 8·761 upper level.	343·244
197.	Lower mitre-sill of lock No. 37 (at heel of N. E. gate, N. lock)	0·000	334·483
198.	On coping, lock No. 37, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M.	18·790 lower level. 8·892 upper level.	353·273
199.	Lower mitre-sill, lock No. 38, at heel of N. E. gate, N. lock	0·000	344·381
200.	On coping, lock No. 38, at end of anchor, N. E. gate, N. lock, marked..	18·520 lower level. 9·787 upper level.	362·901
201.	Lower mitre-sill, lock No. 39, at heel N. E. gate, N. lock	0·000	353·114
202.	On coping, lock No. 39, at end of anchor, N. E. gate, N. lock, marked..	19·830 lower level. 9·306 upper level.	372·944
203.	Destroyed	....	....
204.	Station 97 1-4, on top of coping, end of E. wing, tow-path abutment of farm bridge, marked ⊗, and on face B. M. with chisel	14·010	377·648
205.	Station 178 3-4, on top of coping, at end of W. wing, berme abutment of farm bridge, marked ⊗—B. M. with chisel.	14.463	378·101
206.	Lower mitre-sill, lock No. 40, at heel of N. E. gate, N. lock	0·000	363·638
207.	On top of coping, lock No. 40, at end of anchor, N. E. gate, N. lock	17·080 lower level. 8·556 upper level.	380·718
208.	Station 73 1-4, on top of stone under coping at end of W. wing, tow-path abutment of farm bridge, marked ⊗, and (at end of stone) B. M. with chisel.	12·357	384·519
209.	Station 125, on top of coping, end of W. wing, tow-path abutment of bridge, marked ⊗—B. M. with chisel	12·802	384·964

No.	Description.	Elevation above C. B.	Elevation above T. W.
210.	Station 160¾, on top of stone under coping, W. end of tow-path abutment of farm bridge (near corner) marked ⊗ and B. M. (on end of stone) with chisel	+11·914	+384·076
211.	Lower mitre-sill of lock No. 41, at heel of N. E. gate, N. lock	0·000	372·162
212.	On coping lock No. 41, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel	16·850 lower level. 8·564 upper level.	389.012
213.	Station 30, on top of coping, end of E. wing, tow-path abutment of farm bridge marked ⊗—B. M. with chisel.	12·861	393·309
214.	Station 109, on lower step, E. end of tow-path abutment of Herkimer road bridge, marked ⊗, with chisel	9·994	390·442
215.	Station 180¼, on footing course at E. end of tow-path abutment street railroad bridge, marked ⊗, and on end of stone above B. M. with chisel	9·511	389·959
216.	Lower mitre-sill, lock No. 42, at heel of N. E. gate, N. lock	0·000	380·448
217.	On coping lock No. 42, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel	16·670 lower level. 8·716 upper level.	397·118
218.	Lower mitre-sill, lock No. 43 at heel of N. E. gate, N. lock	0·000	388·402
219.	On coping lock No. 43, at end of anchor N. E. gate, N. lock, marked ⊗—B. M. with chisel	16·500 lower level. 8·431 upper level.	404·962
220.	Station 31, on top of coping at end of E. wing of tow-path abutment of farm bridge marked ⊗—B. M. with chisel	12·554	409·025
221.	Station 67½, top of coping at end of E. wing tow-path abutment of bridge marked ⊗—B. M. (on face) with chisel.	13.124	409·595
223.	Station 130, on top of coping of parapet of aqueduct at W. end marked ⊗, and (on face) B. M. with chisel	12·087	408·558
224.	Station 150¼, on top of coping, end of E. wing tow-path abutment of farm bridge marked ⊗, and (on face) B. M. with chisel	12·864	409·335
225.	Station 185½, on lower step on E. end of tow-path abutment of road bridge marked ⊗, and (on face) B. M. with chisel	11·772	408·243

No.	Description.	Elevation above C. B.	Elevation above T. W.
226.	Lower mitre-sill, lock No. 44 at heel of N. E. gate, N. lock..................	+0·000	+396·471
227.	On coping of lock No. 44 at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel............	19·970 lower level. 9·233 upper level.	416·441
228.	Station 45½, at end of E. wing tow-path abutment of farm bridge, on corner of 4th stone under coping marked ⊗, and on stone above B. M. with chisel.	11·808	419·016
229.	Station 77¼, on face of tow-path abutment of farm bridge, on projection of 5th course from top marked ⊗, and (on stone above) B. M. with chisel...	11·769	418·977
230.	Lower mitre-sill, lock No. 45, at heel of N. E. gate, N. lock..................	0·000	407·208
231.	On coping lock No. 45, at end of anchor, N. E. gate, N. lock, marked ⊗—B. M. with chisel............	20·130 lower level. 8·958 upper level.	427·338
232.	Station 32, on stone under coping, end of E. wing berme abutment of farm bridge marked ⊗—B. M. with chisel.	11·534	429·934
233.	Station 47 3-4, at W. end of berme abutment of farm bridge, marked ⊗—B. M. with chisel........................	11·573	429·973
234.	Station 96 1-2, on top of coping at end of W. wing, berme abutment of farm bridge, marked ⊗—B. M. with chisel.	11·906	430·306
235.	Station 139 1-2, lower step, W. end of tow-path abutment of farm bridge, marked ⊗—B. M. with chisel...............	12·875	431·275
236.	Station 187 1-4, on lower step, W. end of tow-path abutment of farm bridge, marked ⊗, and (on face) B. M. with chisel............................	12·734	431·134
237.	Station 218, on face of tow-path abutment near W. angle on projection of sixth course from top, marked B. M.—⊗ with chisel.....................	11·847	430·247
238.	Station 296 3-4, on face of tow-path abutment of farm bridge on projection of seventh course from top near E. angle, marked ⊗—B. M. with chisel.	11·247	429·697
239.	Station 328 1-4, on face of W. wing tow-path abutment of farm bridge near W. angle projection of seventh course below coping, marked ⊗—B. M. with chisel............................	10·326	428·726
240.	Station 364, on face of tow-path abutment of farm bridge, projection of fifth		

No.	Description.	Elevation above C. B.	Elevation above T. W.
	course below coping, marked ⊗—B. M. with chisel	+12·737	+431·137
241.	Station 387 1-4, top of lower step at end of W. wing, tow-path abutment of farm bridge, marked ⊗, and (on face) B. M. with chisel	13·307	431·707
243.	Station 452, on top of coping of parapet at end of E. wing, tow-path side, Ferguson Creek aqueduct, marked ⊗—B. M. with chisel	9·330	427·730
244.	Station 495 1-2, on lower step, E. wing, tow-path abutment of farm bridge, marked ⊗—B. M. with chisel	11·898	430·298
Three	chains west of Oneida county line (on Middle division), on lower step of E. wing tow-path abutment of Green bridge, marked ⊗, and (on face) ⊗—B M. with chisel	13.619	432·019

(Mitre-sill, lock 46) 418·400, survey of 1876.
(Mitre-sill, lock 46) 416·960, former record.

1·440

MIDDLE DIVISION.

ANNUAL REPORT OF DENISON RICHMOND, DIVISION ENGINEER FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1884.

SYRACUSE, N. Y., *October* 1, 1884.

Hon. ELNATHAN SWEET, *State Engineer and Surveyer :*

SIR — Obedient to the regulations established by act chapter 169, Laws of 1862, I have the honor of submitting herewith my annual report upon the Middle Division of the New York State canals for the fiscal year ending September 30, 1884.

The division extends from the east line of Oneida county to the east line of Wayne county, including the Erie canal between these boundaries; the Black River canal and river improvement; the Oswego canal and Oneida and Seneca river improvements; the Cayuga and Seneca canal, and the numerous groups of feeders and reservoirs from which the water supply is obtained.

The following tables show the lengths of the separate canals, river improvements and feeders, also the water supply as far as measured. No change has been made in the list as reported last year.

Canals.

	Miles.	Totals.
Erie canal, from east line of Oneida county to east line of Wayne county	97·02	
Chenango canal, from Erie canal to lock No. 1	·15	
Black River canal, Rome to Lyons Falls	35·33	
Old Oneida Lake canal, Higginsville to first lock	1·05	
New Oneida Lake canal, Durhamville to Oneida lake.	5·30	
Oswego canal, from Syracuse to Oswego	38.00	
North and south side-cuts and slips at Salina	2·00	
Slips at Liverpool, Oswego canal	·21	
Baldwinsville side-cut	·75	
Cayuga and Seneca canal, Montezuma to Cayuga and Seneca lakes	22·77	
		202·58

River improvements..

Black river, Lyons Falls to Carthage	42·50	
Onondaga outlet, Onondaga lake to Seneca river	·75	
Oneida river, Three River Point to Brewerton at Oneida lake	20·00	

	Miles.	Totals.
Seneca river towing-path, Mud lock to Baldwinsville	5·75	
Seneca river, Baldwinsville to Jack's reefs	11·75	
Ithaca inlet, Cayuga lake to Ithaca	2·05	
Seneca lake outlet, from Cayuga and Seneca canal to Seneca lake	·26	
		83·06

Navigable feeders.

	Miles.	Totals.
Limestone Creek feeder, Erie canal to Fayetteville	·80	
Butternut Creek feeder, Erie canal to Feeder dam above Dunlap's mills	2·00	
Nine mile creek (Camillus) feeder, Erie canal to Camillus	1·00	
Delta feeder, foot of lock No. 9, Black River canal to Delta	1.38	
Black River feeder, Boonville to head of pond at Forestport	12·09	
		17·27
Total		302 91

Artificial feeders not navigable.

	Miles.
Chenango canal, from lock No. 1 to lock No. 77	26.72
Leland pond feeder	·32
Madison brook feeder	3·00
West branch feeder	5·74
Bradley brook feeder	·65
Hatch lake feeder	·23
Kingsley brook feeder	1·93
Oriskany creek feeder	·53
Mohawk feeder at Rome	·05
Oneida creek feeder	3·04
Cowassalon creek feeder	·38
Chittenango creek feeder	·28
Cazenovia lake outlet (improved)	·49
Tioughnioga river feeder	·70
De Ruyter reservoir outlet	·12
Butternut creek (Orville) feeder	·55
Nine mile creek (Camillus) feeder	·65
Carpenter brook feeder	·18
Skaneateles creek feeder	·10
Putnam brook feeder	·20
Centerport feeder	·24
Owasco creek feeder (including 859 feet of iron pipe)	2·10
New outlet of Third Bisby lake	·06
New outlet of Canachagala lake	.16
Total	48·42

WATER SUPPLY.

Erie Canal — Frankfort and Rome levels.

($3\frac{356}{1000}$ miles of Frankfort level on Middle Division. The Rome level, lock No. 46 to No. 47 = $55\frac{957}{1000}$ miles.)

	Cubic feet per minute.
Leland's pond, Madison brook reservoir, Eaton brook reservoir, Bradley brook reservoir, Hatch's lake, Kingsley brook reservoir, Oriskany creek, feed through the Chenango canal into Frankfort level at Utica, half a mile east of lock No. 46, and through Oriskany creek feeder into the Rome level, six miles west of lock No. 46	6,000
Mohawk river, Black river, Forestport pond, White lake reservoir, Chub lake, Sand lake reservoir, Woodhull reservoir, first, second and third Bisby lakes, Canachagala lake, North branch reservoir, South branch reservoir, Twin lakes, feed through the Rome feeder and Black River canal into the Rome level at Rome, fourteen miles west of lock No. 46.	13,000
Oneida creek enters canal through feeder, thirty miles west of lock No. 46	1,000
Cowassalon creek enters canal through feeder, thirty-one and one-half miles west of lock No. 46	200
Cazenovia lake reservoir (for 100 days), Erieville reservoir (for 100 days), Chittenango creek, enter canal through Chittenango creek feeder, forty-one and one-half miles west of lock No. 46	5,641
De Ruyter reservoir (for 100 days) enters canal fifty miles west of lock No. 46	3,891
Limestone creek, natural flow, enters canal fifty miles west of lock No. 46	500
Jamesville reservoir (for 100 days) enters canal fifty-two miles west of lock No. 46	2,000
Butternut creek, natural flow, enters canal fifty-two miles west of lock No. 46	500
Total	32,732

Short level, from lock No. 47 to No. 48 = $\frac{188}{1000}$ of a mile. Fed from Rome level.

Mile level, from lock No. 48 to No. 49 = $\frac{714}{1000}$ of a mile. Fed from Rome level through Short level.

Syracuse level, from lock No. 49 to No. 50 = $5\frac{14}{1000}$ miles. Fed from the Rome and Jordan levels.

Jordan level, from lock No. 50 to No. 51 = $14\frac{903}{1000}$ miles.

Otisco lake reservoir enters canal through Nine-mile creek (Camillus) feeder, four miles west of lock No. 50	5,146
Nine-mile creek, natural flow, enters canal through feeder, four miles west of lock No. 50	800
Carpenter brook enters canal through feeder, ten miles west of lock No. 50	200
Skaneateles lake reservoir feeds into canal at Jordan, thirteen miles west of lock No. 50	8,766
Total	14,912

Port Byron level, from lock No. 51 to No. 52 = $7\frac{793}{1000}$ miles.
Fed from Jordan level through lock No. 51.

	Cubic feet per minute.
Putnam brook feeder at Weedsport	200
Owasco lake reservoir, through feeder at Port Byron	4,033
Total	4,233

Montezuma level, Lock No. 52, to Wayne county line = $9\frac{98}{1000}$ miles.

Fed from Port Byron level, through lock No. 52, amount from Lake Erie	4,000

Oswego Canal.

Erie canal at Syracuse	10,000
Seneca river	54,000
Oneida river	20,000
Total	84,000

Cayuga and Seneca Canal.

Seneca lake	18,000
Erie canal at Montezuma	4,000
Total	22,000

Black River Canal and River Improvement.

	Elevation in feet above tide water.	Surface area in acres.	Average area in acres.	Av. depth in feet.	Capacity in cubic feet.
Canal.					
White lake reservoir	.....	.....	296	5	64,468,800
Chubb lake reservoir (approximate)	1,599	.....	200	4	84,848,000
Sand lake reservoir	.....	.....	306	15	199,940,400
Woodhull reservoir (two years in filling)	1,854	1,236	1,118	18	876,601,440
First, Second and Third Bisby lakes (approx'ate)	.....	.....	.....	3½	40,000,000
Canachagala lake (approximate)	.....	.....	320	4	55,756,800
North lake reservoir (can fill twice yearly)	1,821	423	277	28	337,851,360
South lake reservoir	2,019	518	372	26	421,312,320
Twin lakes (approximate)	.....	.....	175	8	60,984,000
Forrestport pond	.....	.....	.....	..	....
Mohawk river through Delta feeder	.....	.....	.....	..	....
Pond above Lyons Falls dam	.....	.....	.....	..	....
River Improvement.					
Forge pond	.....	.....	.....	..	....
First lake of the Fulton chain	1,691	.....	.....	..	....
Second lake of the Fulton chain	1,691	.....	.....	..	....
Third lake of the Fulton chain	1,691	.....	.....	..	....
Fourth lake of the Fulton chain	1,691	.....	.....	..	....
Fifth lake of the Fulton chain	1,691	9	.....	..	....
Sixth lake of the Fulton chain	1,772	109	.....	..	....
Seventh lake of the Fulton chain	1,772	867	.....	..	....
Eighth lake of the Fulton chain	1,776	309	.....	..	....
Black river	.....	.....	.....	..	....
Moose river	.....	.....	.....	..	....

SUMMARY OF WATER SUPPLY.

Erie Canal.

	Cubic feet per minute. Amounts.	Totals.
Frankfort and Rome levels	32,732	
Jordan level	14,912	
Port Byron level	4,233	
Montezuma level	4,000	
		55,877

Oswego Canal.

From Seneca river	54,000	
From Oneida river	20,000	
		74,000

Cayuga and Seneca Canal.

From Seneca river	18,000	18,000
Total water supply		147,877

The latter part of the season of 1883 restored the water supply, which was so low at the beginning of that year, and the canals opened in 1884 with every reservoir full or only a little down. This condition of the reservoirs was fortunate, as the season has been a dry one and the evaporation excessive.

No trouble from low water has been experienced, except for a few days about the middle of August on the long level when the feed from the Black river reservoirs was not received as promptly as usual after the gates were open, because of the loss in filling up the dry, natural channels and intervening swamps.

At this time the water from the Woodhull reservoir occupied nearly six days in reaching the Erie canal, with a full reservoir and all gates hoisted, as I am informed by the superintendent in charge.

The construction of the proposed reservoir at Forestport will give a supply so much nearer the canal that any sudden draft on the long level can be promptly supplied and a more even surface maintained at all times.

Considerable time is always lost in sending special messengers to the most distant reservoirs over bad roads, which could be obviated and a much better system of communication established by telephone, when the condition of the water could be regularly reported to the assistant superintendent and recorded for future reference, as is now done with all other reservoirs, and any sign of weakness could also be reported and more quickly attended to.

Summary of Structures.

CANALS AND WATER-WAYS.	MECHANICAL STRUCTURES.												
	Lift locks.	Guard locks.	Weigh locks.	Aqueducts.	Culverts.	Waste-weirs and receivers.	Spill-ways, sluices, over-falls and bulk-heads.	Stop and guard gates.	Bridges.	Dams.	Light-houses	Piers and break-waters.	Totals.
Erie canal	....	1	12	82	14	7	....	....	162	....	....	....	278
Oswego canal	5	1	1	5	15	19	75	....	48	7	....	....	171
Black river canal	....	....	6	10	..	109	10	....	66	....	....	....	201
Cayuga and Seneca canal	....	....	....	9	1	12	3	....	83	5	1	4	68
Oneida lake canal	....	....	....	4	....	6	....	1	7	....	....	2	20
Chenango canal used as a feeder	....	....	4	20	....	77	1	....	40	....	....	....	142
Black river feeder	1	....	....	3	4	....	....	....	13	1	....	....	22
Other feeders	1	....	....	4	7	....	16	2	67	24	....	....	121
Side-cuts and slips	....	....	....	....	....	....	2	....	6	....	....	....	8
River improvements	1	....	....	....	....	5	....	....	18	4	1	6	35
Totals	8	2	23	137	41	235	107	3	455	41	2	12	1,066

OTHER STRUCTURES.	
Railroad tunnel	1
State shops	8
Division walls	3
Feeder pipe	1
Total structures on middle division	1,079

Navigation.

All the canals on this division were opened and ready for navigation May 6th, one day earlier than the year previous. Navigation has been uniformly good. The freedom of the division from breaks and failures is mainly due to the care and watchfulness of superintendents in charge who have consulted the engineer department when signs of danger of any description were observed and precautionary measures have been promptly taken as directed. A few unforeseen disasters have occurred, only two, however, interfered with the boating interest.

At Utica the caving in of the towing path required the level to be drawn down two feet, detaining loaded boats about twelve hours.

At Lyons Falls the failure of a waste weir and break through the bank stopped navigation on the Black River canal nearly eight days. These constitute the only detentions on the division worth mentioning.

Break at State Street, Utica.

September 21st the ground in rear of and including the towing path at State street, Utica, suddenly caved in and the water from the canal rushed into the cavity. It was at first supposed the connection of the city sewer, a brick arch with the forty-eight inch cast iron pipe that was laid under the canal in 1877, had failed. The water was quickly drawn down and a sheet piling cut-off made. About one hundred cubic yards of material were found to have disappeared, but subsequent examinations made as thoroughly as possible without endangering navigation, indicated the city sewer to be uninjured and the apparent sudden loss of material in this view of the case might be accounted for as follows:

The connection was not made at the time the pipe was laid and it was necessary when this was done to make a cut, of fifteen feet. The bottom being quicksand the filling over the city sewer was composed largely of the same material which wasted through the newly constructed arch as the work progressed, on a down grade to the river. The underlying quicksand was thus drawn away at the upper end of the work and a cavity formed, when the breaking of the crust over the same, where heavy blocks of granite had been deposited, caused the caving toward the canal which allowed the water to pour in. In 1879, a similar break occurred over the connection of the sewer with the pipe on the berme side. At this time, however, the city sewer was found to have failed and upon the recommendation of the engineer department the city of Utica added two or more lengths of pipe which carried the connection so far from the canal that it could be uncovered in case any repairs were needed without endangering the canal, or sewer, as a break into it would undoubtedly damage it materially.

For the future safety of the canal and sewer, I would recommend the same course be pursued with the towing path side. The State laid the pipe across the canal and stopped at the blue line boundaries. The sheet piling cut-off allowed the canal to be refilled and the hole was then pumped out and excavations made to examine the sewer.

Clay and gravel was boated to the spot and puddled back. Several sheet piling courses were driven over and around the pipe to hold back the quicksand.

Leak at Durhamville.

A failure of a singular character occurred at Durhamville where the Oneida creek passes under the Erie canal through a double arch culvert of twenty-five feet chords, while the banks at this point are about thirty feet high. It was just after the close of navigation and when the head of water on the long level had been reduced about three feet, that the water commenced pouring out at the foot of the high embankment near the south-east end of the culvert wing.

The water was drawn off as quickly as possible, and dams built each side of the culvert to maintain some water in the level through the winter. The work of repair was immediately commenced and an excavation made entirely across the canal, thirty to forty feet wide and ten feet below canal bottom, where a mass of loose stone filling and old masonry was uncovered.

Nothing more was done until the frost was out in the spring, when it became evident that the cause of the leak was the gradual wearing away of the lining over the loose stone mentioned, during periods of freshets in the creek; and as this loose material extended, no doubt, to the bottom of the culvert and under the embankment, it was decided to concrete over the stone, grouting where required and then refill with puddled clay and gravel. This was done in a thorough manner and no sign of a leak has been observed since. The repair was not completed until just before the time for opening the canals, and had it occurred earlier in the season, would have stopped navigation for several days at least.

Ordinary repairs made during the fiscal year, and repairs recommended — Erie canal.

Bottoming out was done by all the section superintendents, especially on the towing-path side; only the worst places, however, received attention; when the material was suitable, it was deposited on the towing-path or used in raising or strengthening the berme banks. Vertical walls where they had fallen down were rebuilt and the top of the slope walls more or less repaired. The wash from steam and excursion boats, however, keep the slope walls for two or three feet down from the top in bad condition by washing out the lining, and finally the wall fails and the wash-out would extend through the bank and cause breaks if not cared for. The section scows have distributed large quantities of stone and gravel in their endeavor to keep pace with this loss of material, but it is found impossible to do so, and in passing over the canals it is apparent that although much work has been done and many dangerous places repaired, the general appearance is not much improved from last year, and there is little prospect of keeping them perfect even if restored to their original condition as long as these boats continue their present rate of speed. A muddy receding wave follows along the wall continuously from behind their wheels, and at every trip they must do considerable damage of a nature difficult to repair.

More than the usual amount of new docking has been put on. Particular attention has been given to the towing-path this year, ; the material has been scraped from the back side to the front, and back ditches opened which will allow better drainage and insure a dry towpath, and at the same time protect the paving.

The Superintendent of Public Works also placed four gravel scows on the division specially built for the purpose, having greater capacity than the ordinary section scow, and conveniently arranged for the work of graveling and raising the banks. As these boats are not generally called upon to do ordinary repairs, the steady work of improving the banks show good results.

In cities and villages the canal has become a receptacle for offal and filth of all description, requiring much labor to remove. The refuse of many manufacturing establishments is emptied into the canal while it is filled and is seen in unsightly piles after it is drained. The sewage matter along the basin or gulf in the city of Utica is poured into the canal and contaminates the water, while the removal of the solid portion became a necessity in the spring. To remedy this a sewer of sufficient capacity should be constructed across the canal to the river.

Locks.

Lock 52. In October last a leak under the foundation of lock 52, at Port Byron, interfered with the operation of the locks, and only by using the double locks simultaneously could boats be passed. The service of a professional diver from the Eastern Division was secured and temporary repairs made by respiking the plank and securing them with new binders. After this repair no further trouble was experienced during the season.

Before the opening of navigation this spring the floors were removed in both the locks, and the spaces washed out between the foundation timbers and across the culvert were refilled with broken stone concrete, rammed to place with iron rods. It was then replanked and relined with new binders in both chambers; the locks were then repointed with Portland cement; mitre-sills repaired and put generally in first-class order. A new pier was built at the foot, and the one at the head repaired.

This failure, with that of lock 48 last year, was owing to the use of wooden piers when originally built. The plank had become water-worn around them and thereby loosened. It was decided to examine all the locks by boring through the floors, but no other cavities of any magnitude were found.

Lock 51. Repairs were made to pier.

Lock 50. Lock was coffer dammed and pumped out, when the planking was found to be poor. This was partially renewed and mitre-sills repaired.

Lock 49. New lower pier was built.

Lock 48. Concreted under tumble gates; mitre-sill repaired; culvert cleaned out and repointed.

Lock 47. Culvert cleaned out and repointed, and new tumble gate inserted.

Lock 46. Concreting was done among the timbers of the apron of the tow-path lock and new bottom plank put on; apron in berme lock was replanked; one pair of upper gates was put in. In addition to the above, repairs were made to the machinery and gates of all the locks.

Dams.

New face plank were put on Cowassalon feeder dam, and apron was also repaired.

Protection walls at Rome feeder dam were extended and completed. A hole is washed out at the foot of the apron at the south end. The dam should be protected with a crib filled with stone.

Limestone creek feeder dam was repaired, but is badly decayed and should be rebuilt of stone. A new apron 250 feet long has been built at Oriskany dam, and the dam proper replanked, as it leaked badly. A portion of the old apron of this dam was washed away as low as the bottom of the river this spring.

Waste-weirs and bulk-heads.

Waste-weir on Limestone creek feeder was repaired. The wing walls of Pool's brook waste-weir were extended to strengthen bulkhead. New gate house has been built at Fort Bull waste-weir.

Waste-weir bulk-head between bridges Nos. 32 and 33 needs repair.

Waste-weir east of Higginsville should be taken down and rebuilt; walls are braced.

Culverts.

Nearly one-half of the eighty-two culverts on this division of the Erie canal are single, double or triple stone arches, requiring few repairs, except to the wings and parapets; the balance are mostly composite with masonry at ends. The parapets and wings of all the culverts abutting against the slope of the banks are easily affected by frost, and the masonry and coping of many of them are more or less displaced. A few have been repaired this year.

The wings of the culvert at Port Byron, between bridges Nos. 135 and 136, should be taken down and rebuilt, as they are in danger of falling. This should be done while the water is out of the canal. The balance are mostly composite, having wooden trunks with stone breast walls; the intention of which was to hold back the water in the streams sufficient to keep them always under water, thus preventing decay. During dry seasons, however, when the streams are low, or from displacement of the coping or leakage, they are often left exposed to the weather, and now show some signs of rot at the ends. When they are actually weak a settlement occurs, and in such cases they should be uncovered and examined. The culvert known as Kirley's, near Oriskany, is in this condition, and may be found so bad as to require a new trunk entire. The parapets and wings should be relaid, as the stone are displaced. The parapet and wings of Harbor brook culvert, and culvert between bridges 52 and 53, are also crowded over by frost, and should be taken down and relaid.

After the water was drawn off the Frankfort level, sink holes were noticed over the Nail creek culvert arch at the south-east side, and upon digging down it was found that in the repair of the original break, which was done hurriedly, a mass of loose stone had been covered imperfectly with concrete. These were taken out as low down as possible, and then grouted, after which the clay was puddled back. As both sides of the culvert entirely across the canal have now been repaired in this manner no further trouble is apprehended.

Ditches leading from many of the culverts have been re-opened and the culverts cleaned out. The annual deposit in some of the large culverts is considerable. The starch factory culvert, east of Utica, has three arches, and the openings were nearly closed up. The wooden-box culvert leading from Schwab's dry dock, Utica, where a break occurred last year, has been permanently closed up. The culvert leading from the dry dock at New London was uncovered and repaired. Nelson brook culvert at Erieville, a stone arch has been rebuilt from the foundation.

Aqueducts.

Crane brook aqueduct had three new gates.

Deposits under Cowassalon aqueduct trunk have been removed.

Minor repairs were made to other aqueducts.

Eleven spans of the Montezuma aqueduct were removed from the west end in 1882.

Nothing was done in 1883 or in 1884. As the present trunk was all rebuilt in 1873, and is found to be decaying, it should be gradually renewed. Timber for two spans has been delivered.

The stone work is very perfect, but should be repointed to keep it so.

Port Byron aqueduct needs new sides.

Centerport aqueduct needs new railing.

Jordan aqueduct needs new plank and gates.

Limestone aqueduct needs new plank.

Chittenango aqueduct needs new stringer bridge.

Cowassalon aqueduct needs new plank and guard rail.

Oriskany aqueduct leaks at ends.

Bridges.

Most of the bridges have had repairs, especially to the wood-work, some a few plank, and others an entire new floor.

On section 7 the bridges have all been painted and numbered, and the abutments repaired and repainted ; this has greatly improved the appearance of these structures.

On other sections this has not as yet been so generally done. The approaches to several of the bridges have been raised and new guard railings built.

Peterboro street bridge, Canastota. Complaint was made by the village authorities of the contracted sidewalk, forming part of this bridge, which they claimed caused great inconvenience, as the footways were frequently blockaded, more especially the west side, which receives the greatest amount of travel. Upon investigation this was found to be the case, and as the village had recently improved their street by paving with Medina sandstone, including the approaches to the bridge, the Superintendent of Public Works decided to widen the west side to twelve feet and erect a new sidewalk truss to support it. The work was done upon the plan as approved, and has greatly accommodated the citizens thereby. Suitable iron guard rails have been attached to the bridge and abutments.

Bridges Rebuilt.

Starch factory bridge, No. 2.
Hotel street lift bridge, Utica, No. 9.
Clark's farm bridge, No. 32.
Pool's brook bridge, No. 80.
Kirkville bridge, No. 81.
Geres farm bridge, No. 110.

Bridges that should be Rebuilt.

Platt street, Utica (No. 17), should be taken down and foot bridge built.

Road bridge over feeder at Oriskany.
Brainard's farm bridge, No. 29.
Parkhurst farm bridge, No. 30.
Kirley's farm bridge, No. 31.
Burns' road bridge, No. 43.
Herrig's road bridge, No. 46.
Lenox basin bridge, No. 67.
Fuller's bridge, No. 72.

May's Point change bridge, No. 19, and New London bridge, No. 49, should have new iron needle beams. These have been delivered ready for insertion.

Gere's landing bridge, No. 109, and Beaver street, Jordan, No. 119, need new wooden needle beams.

General repairs to floors will be required as heretofore.

OSWEGO CANAL AND TRIBUTARIES.

Oswego Canal.

Some bottoming out was done, followed by dredging after the canal opened.

General repairs have been made to all the bridges, and new docking or vertical wall built where necessary to protect the towing path.

Locks.

Lock No. 1.— New balance beams were put on and paddles repaired; needs new lower gates; covered sluice around lock 1 and lock 2 has been repaired, should be rebuilt for about 300 feet.

Lock No. 2.— Gates were repaired and new foot bridge rebuilt.

Lock No. 3.— Paddles were repaired.

Lock No. 4.— (Side cut lock.) Lower gates were put in; needs two new mitre sills laid.

Lock No. 5.— Gates were repaired: pier at foot should be rebuilt four feet down from top.

Lock No. 6.— Needs pointing and new lower gates; docking at foot needs repairs.

Lock No. 7.— Needs two new mitre sills and repairs to floor, also lower gates; this lock should be repaired immediately after navigation closes; to do so it will require coffer dams above and below the lock as there will be eight or nine feet of water on the foundation at a low stage of the river; repairs were attempted this spring but the water was too high; at best the leakage will be so great as to require larger pumps than is generally used on canal work.

Guard lock No. 3.— Docking at head is poor.

Lock No. 8.— Needs all new gates.

Lock No. 11.— Two new gates were put in; needs new docking at foot of lock.

Lock No. 12.— Needs new upper gates; 100 feet of vertical wall was built at foot of lock.

Lock No. 13.— Needs new balance beams.

Lock No. 15.— Needs one upper miter sill.

Lock No. 16.— Needs repairs to pier at foot of lock.

Lock No. 18.— Needs all new gates.

Bridges Rebuilt.

Clarke's bridge over south side cut.

Tow-path bridge at Three River Point, six spans.

N. Y. C. R. R. bridge has been raised as directed.

Change bridge, No. 11, has also been raised.

The following bridges are old and should be rebuilt, viz.:

Berry's and Avery's bridges over north side cut.

Foot bridge over Liverpool slip.

Bridge street, Phœnix.

Change and road bridge, Phœnix.

Hinmanville road bridge.

Pratt street bridge, Fulton.

Littlefield's change bridge.

The bridges generally need painting. Six spillways and several sluices have been rebuilt or filled up when found to be no longer required.

Oneida River Improvement.

At Caughdenoy fender piles have been driven above and below the lock. Docking at foot of the lock rebuilt and foundation of swing bridge repaired.

At Oak Orchard fender piles have been driven above and below the lock extending to the swing bridge. Two new lock gates inserted. The Oak Orchard swing is old and should be rebuilt this winter. The timber is delivered. One of the needle beams broke in August, letting a man with team and portable engine fall to the bank of the river. The bulk-head at end of dam was rebuilt and pier masonry relaid.

The cribs protecting swing bridge were rebuilt and refilled with stone.

Dams and Bulk-heads.

Phœnix dam.— Three new bulk-heads are building at the west end of the dam and two across the side canal at the east end. Three other bulkheads at the east end should be rebuilt, another year, which will complete these structures.

Oswego Falls dam.— Three new bulkheads have been put in at east end of dam.

Fulton dam.— The bulk-head at the east end of the dam should be rebuilt this fall. This bulk-head is fifty-five feet long and the water will be about fourteen feet deep. The coffer dam will be located just above the bulk-head and as the space is filled in by refuse from the saw-mill, located near the dam, the services of the State dredge will be required to clear the channel before the dam can be built. New lock-gates should be placed in the guard-lock connected with the bulk-head, or the present ones protected from the ice as they are old and rotten. The bulk-head at the east end is also poor and should be rebuilt; two crib ice-breakers should be repaired.

Van Buren dam.— The old bulk-heads have been protected with timbers as they are not used.

Minetto dam.— Three new bulk-heads have been inserted at the west end of the dam; the old ones were damaged by the ice and high water and came near being carried out; three crib ice-breakers were built five timbers high and abutments repaired.

The four bulk-heads across the Mill companies race, at Oswego, are old and decayed.

Sloping aprons.

The sloping aprons at Phœnix and Van Buren dams were never completed. At least one of these should be finished next year.

Baldwinsville Canal.

Some repairs have been made to dam and lock. Two sluices need rebuilding and float bridge repaired.

Oneida Lake Canal.

The elevated bridges, with their approaches, on this canal should be lowered, as the superstructures become unsafe, and culverts built instead, using the abutment stone.

Kelley's road bridge, being in a dangerous condition, was taken down and temporary crossing made in the prism just below.

The bents under Tubb's road bridge should be renewed if the superstructure is to be maintained.

The bridge at South Bay, also, should be rebuilt.

Cayuga and Seneca Canal.

Little bottoming out was done, but the State dredge has worked on the canal and at Cayuga and Geneva harbors, as the lakes have been very low. Eel grass has been troublesome and required cutting.

Locks.

Lock No. 1 requires two balance beams and new docking at head of lock.

Lock No. 2.— Two new upper gates were put in, and the lower gates repaired; needs one balance beam, and new docking at head of lock.

Lock No. 3.— New docking has been built at head of lock, and walls pointed above low water. This lock leaks more than any other on the division, and the taking down and relaying of the walls has been recommended. I think, however, it might be pumped out and the planking removed, when concrete could be worked under the walls and between the foundation timbers sufficient to remedy the difficulty. The portion that is under water now could then be carefully pointed. The trouble with the lock is the poor quality of the cement used when rebuilt.

The lock needs four new balance beams; the upper gates are also old; the high vertical wall at the side of the lock has been in danger of falling for several years, and has been recommended to be taken down and relaid.

Lock No. 4.— Gates have been repaired and one side of the lock replanked.

Lock No. 5.— New docking has been built at foot of lock. This lock fills up badly with sediment, and should be pumped and thoroughly cleaned out.

Lock No. 6.— Needs repointing; upper gates are old.

Lock No. 7.— Has had repairs; all gates are old.

Lock No. 8.— Walls have settled at head of gates and lining is old; will require pumping to repair.

Lock No. 9.— Needs pointing and a new balance beam.

Lock No. 10.— Four new gates were put in and chamber repaired; needs pointing.

Lock No. 11, at Montezuma.— Two new gates were put in; the facing of the lock is poor and the walls need pointing; the flume around the lock is so dilapidated that it will require rebuilding before the opening of navigation next year; the timber has been ordered; it will take about 27,000 feet B. M.

Bridges.

Bridges have generally had repairs, but none completely rebuilt, except some small ones.

The long towing-path bridge across the river at Seneca Falls has settled and required shoring; it should be rebuilt, together with the end wooden abutments; the piers are in good condition.

The towing-path bridge over the slip at Seneca Falls is bad; both spans should be rebuilt; the timber has been purchased.

The tow-path abutment at Canal street bridge, Geneva, is undermined; it should be protected from further damage.

All the iron bridges need painting.

Dam at Waterloo.

About forty feet of the upper portion of the State dam at Waterloo, which holds back the waters of Seneca lake, was carried away April 12th. The water poured through the breach with great force, wearing away the material and endangering the balance of the dam. As it was necessary to check the flow as quickly as possible, stone were boated from the nearest quarry and a dam of loose stone constructed around the break and as near to it as the current would permit. This was a safe and comparatively inexpensive cut off.

Later in the season, after Seneca lake had been drawn down, and the break in the timber work of the dam was being repaired, it was found that the wood work was so unsound and out of line that there was danger of its being carried away bodily with the next high water unless it was materially strengthened by bracing or partially rebuilding.

The State's portion of the dam is 190 feet in length with a bulkhead attached. The bulk-head, with the abutment walls, were unsafe, as was also the north abutment of the dam, while the entire structure leaked badly. The foundation is solid rock, and being in a section where good stone can be procured, I would recommend the building of a stone dam immediately below and abutting against the present one; also new stone abutments and timber bulk-head or flood-gates.

This can be done in the early fall to the best advantage, while the lake is low.

The immediate construction of this dam is anticipated, and the Assistant Superintendent of Public Works is now rebuilding the bulkheak and abutments in conformity with a plan that has been furnished by this department, showing proposed new structure entire.

Miscellaneous.

The pile docking at Geneva has been in bad condition for several years, requiring annual repairs. The piles should be cut off at low water line and a crib docking made·

About one-half of the Cayuga pier needs rebuilding three to four feet down from the top. The timber has been ordered. Fifty fender and guard piles should be driven above and below the railroad bridge to assist boats in making up their tows and entering the canal.

A new section scow should be furnished for this canal.

Black River Canal and River Improvement.

Considerable bottoming out was done before the opening, but there is still much material above canal bottom requiring the levels to be kept so full as to injure the sluices around the locks. The steam dredge has been constantly at work on the river.

June 8th. The wooden spillway on the short level at Lyons Falls was entirely washed out and the structure carried to the river a total wreck. The structure was twenty feet high including over-falls, and the breach about fifty feet wide. It was necessary to rebuild the spillway to regulate the water of this level, requiring much framing and necessarily slow work in puddling back selected material. The water followed the natural channel to the river, causing no land damages.

Locks.

Bush's lock on the Black river is a timber structure large enough to pass steamboats. The sides are badly decayed down to low water mark and the work of rebuilding has commenced. It is not thought, however, that more than one side can be completed this fall. Four new gates are to be inserted and mitre-sills repaired. Otter creek lock is a similar structure and although its general appearance is better, it will no doubt be found in bad condition when the lining is removed; a new gate and other repairs will at least be necessary; forty-nine new lock-gates have been inserted in the canal locks and about 100 balance beams put on, while most of the locks have been more or less repaired; it is estimated that as many new gates will be required another year; fourteen locks on section No. 1 and some on No. 2 have been repointed; the chambers of a few have been dressed off where they were crowded over by the action of frost; new docking has been put on at the head of the locks from 31 to 74, inclusive; on section No. 1, particularly, the banks around the locks and the towing-path generally have been repaired with slate and gravel; many of the sluices and waste-weirs have been repaired or rebuilt; other locks should be repointed another spring.

Bridges.

All the river bridges have been replanked; the wrought-iron bridge at Carthage has had extensive repairs; a teamster and horses with load of timber broke through the Illingsworth swing bridge in July, owing to failure of one of the needle beams; new ones were inserted. The Parker Beach and Glendale bridges were repaired; two new spans across the Beaver river, at Naumburg, are now building; twelve new bridges have been built and the following need rebuilding: Forestport, Stefhann and Manchester bridges over the Forestport feeder, and the Yerden tow-path bridge at Delta, Farr bridge, Crowell bridge and bridge near Westernville, over the canal.

Dams.

The Delta dam that turns the Mohawk river into the Black River canal, a few miles above Rome, is a timber structure over 200 feet long and has had extensive annual repairs; the spring floods having washed away portions of the crib apron; this year it was decided to rebuild the same upon a more substantial plan, which has been approved by the State Engineer and Surveyor, and the work is now in progress; over 100 piles will be required to which the solid timber apron will be securely anchored; the dam, proper, will also be repaired and refilled with stone where washed out; the entire structure will then be in thorough repair.

Miscellaneous.

The channel at A. Hall's culvert was cleaned out and 500 lineal feet of slope wall at the sides overhauled or rebuilt. Lansingkill feeder has been cleaned out and 200 lineal feet of slope wall put in at the side of the creek near Dunnbrook to protect the towing-path. A new bulkhead has been built at lock 70. Well's creek aqueduct should be entirely rewooded.

Reservoirs.

The wooden discharge culverts to North lake reservoir were rebuilt; five in number.

Roads leading to the North Woods reservoirs have been repaired; new corduroys built and brush cut.

Eaton brook bulk-head has been rebuilt and dam repaired.

The paved waste at Eaton reservoir needs repairs; many of the stringer bridges over the feeders have been rebuilt.

The Solesville aqueduct and bulk-head have been rebuilt.

Repairs have been made to the road and around the dam at Otisco lake reservoir.

Madison brook feeder is badly filled up and should be cleaned out this fall.

The protection wall along the pond at Bradly brook feeder should be extended.

One of the valves leak badly at De Ruyter, the connecting bolts being broken.

The reservoir will be drawn down when new bolts can be inserted.

The well-house also needs repairs and a new rack built at the feeder dam.

The protection wall below the Owasco lake bulkhead is undermined.

Two new bulk-heads should be built at Skaneateles dam; this work will require the use of a pump and about 100 feet of coffer dam above, and also a dam below the bulk-head; it will not be safe to defer this work another year, although the water will be higher than usual in the lake and not less than eight feet deep above the sill; when the water is out, the masonry should be thoroughly repointed.

The channel through which the water is drawn to the bulk-head is an artificial one extending out into the lake several hundred feet and is protected at the sides by coffer dams coursed with stone. The east coffer which protects the channel the most has been uncoursed or worn away for about 300 feet from the upper end. The stone should be replaced as the drifting sand is filling up the channel, while the timber portion is exposed and liable to be washed away.

Special Appropriations.

Forestport Reservoir.

Chapter 453, Laws of 1883, appropriation $20,000.

The construction of this reservoir now seems to be assured with a probability of commencing the work this fall.

An additional appropriation, however, will be necessary to make a reservoir of sufficient capacity to secure a supply that can be relied upon to feed the Rome level in case of emergency when other sources are exhausted or difficult to obtain in time for immediate relief.

Late in the fall of 1869, a preliminary survey for this reservoir was ordered by Hon. Horatio Seymour, jr., State Engineer and Surveyor, to get such information as could be obtained in about ten days. From notes then taken it was estimated that a fifteen-foot flow line would inclose 700 acres giving an average depth of seven feet. In 1881 an accurate flow line was surveyed by C. L. Phelps, twenty-one feet above the surface of the Forestport pond or crest of State dam below, and a map of the same made. Accurate calculations give the amount of land inclosed as 792$\frac{84}{100}$ acres, as recommended in last year's report of D. E. Whitford, division engineer.

I would advise the dam to be built at least fifteen feet above the surface of the pond, this would make the entire height of the dam to the bottom of the river about twenty feet, and abutments twenty-five feet; a plan with these dimensions has been prepared; the spillway and apron to be about 200 feet in length, built in the crib form and filled with stone; the abutments to be of stone and the cross walls through which the cast-iron feed pipes are to be laid to be of stone also; to the lower end of the pipes it is proposed to attach the most approved form of valves, and for protection and convenience in operating to construct over the same a suitable well-house which can be reached by an iron ladder attached to the face of the cross wall.

The soil is sand intermingled with small stone and boulders, which will require blasting to remove, these can be finally used for filling cribs and protection walls; clay for puddling can be procured a short distance from the site of the dam along the banks of the river; piles can no doubt be cut from timber within the flow line; good stone for the abutments can be quarried along the Sugar river and boated up the feeder to the pond and perhaps to the dam; the greater portion of the flow ground will require cleaning, as it is covered with second growth timber; two roads cross the reservoir and will have to be raised and new bridge abutments built; the lower bridge should have an additional span as the water-way is so contracted that the abutments are being undermined.

With a fifteen-foot dam as before stated about 700 acres will be flowed with an average depth of seven feet, giving a capacity of 213,444,000 cubic feet. As the feeder at Rome has been calculated to furnish 13,000 cubic feet per minute, the amount stored would be sufficient to feed the canal eleven and one-half days if filled but once. The river, however, rises rapidly from the effect of summer rains so that it would be likely to be filled several times and can be kept so from the reservoirs above holding the water so received twenty miles nearer the Erie canal.

Lowering Columbia and Fayette Street Bridges over the Chenango Canal at Utica.

Chapter 482, Laws of 1884, appropriation $3,000.

This law provides for rebuilding the bridges or for constructing culverts in place thereof. Nothing has as yet been done under this law, but the sum appropriated will, I think, be insufficient to lower the approaches and construct more than one stone culvert, and it is even doubtful if that can be built and the street paved for the amount named.

Dredging Cayuga Inlet.

Chapter 491, Laws of 1883, appropriation $2,500.

The work has been done to the extent of the appropriation.

Lengthening Lock 50.

Chapter 80, Laws of 1884, appropriation $30,000.

The necessary measurements for the work were taken before the canals were opened, and all plans and bills of materials have been made ready for commencing the work as soon as navigation closes.

The new lock will rest on a pile foundation, and be an extension of the berme lock, having same length and width of chamber as the present one, which makes the chamber when used as an enlarged lock 220 feet between quoins. This will admit two boats coupled together, and as the lower gates of the present lock will be retained in their present position either lock can be used for single boats if desired.

The device in operation on most of the Erie canal locks on this division should be attached to assist boats towed by horses in entering and leaving the lock.

Completing Fishways on the Oswego River.

Chapter 501, Laws of 1884, appropriation $2,500.

No work has been done under this law, which is intended to provide for fishways at the Fulton, Oswego Falls, Phœnix and Baldwinsville dams. The four fishways put in last year at the Oswego, High, Minetto and Van Buren dams, on the Oswego river, were uninjured by high water or ice, and evidences of their efficiency are said to have been observed this summer.

ENGINEER DEPARTMENT.

The small force employed during the past year in the engineer department has been kept busy in the office preparing and copying maps, plans and bills, or in the field supervising work in progress. Good success has attended the construction of all work done under their direction, while the relations existing between the engineer and superintendent departments have been mutually pleasant. The provisions of special laws and resolutions have made extra work for the force, while some time has been occupied in preparing maps and in attendance at the sessions of the court of claims. During the fiscal year this department has been in charge of Denison Richmond, division engineer, and David E. Whitford and R. R. Stuart, assistant engineers.

Following is a tabulated statement of engineering expenses:

The total expenditures are,

For ordinary repairs	$6,750 52
For extraordinary repairs	160 20
Total	$6,910 72

Comparative statement of engineering expenses on this division for the last five years:

For fiscal year ending September 30, 1880	$11,162 01
Eor fiscal year ending September 30, 1881	14,095 58
For fiscal year ending September 30, 1882	9,518 44
For fiscal year ending September 30, 1883	9,172 31
For fiscal year ending September 30, 1884	6,910 72

Very respectfully yours,
DENISON RICHMOND,
Division Engineer.

Statement showing the names, rank and compensation of engineers on the Middle Division of the New York State canals, together with the incidental expenses from October 1, 1883, to September 30, 1884, inclusive.

ORDINARY REPAIRS — ERIE CANAL.

	Amount.	Total.
David E. Whitford, division engineer, salary $2,400	$400 00	
David E. Whitford, division engineer, travel	78 73	
Denison Richmond, resident engineer, salary $2,000	200 00	
Denison Richmond, resident engineer, travel	37 81	
Denison Richmond, assistant engineer, 4 days at $5 per day	20 00	
R. R. Stuart, assistant engineer, 34 days at $5 per day	170 00	
R. R. Stuart, assistant engineer, travel	24 16	
R. R. Stuart, rodman, $68\frac{4}{7}$ days at $3.50 per day.	240 00	
R. R. Stuart, rodman, travel	28 78	
Arthur V. Meeker, leveler, 39 days at $4.50 per day	175 50	
Arthur V. Meeker, chainman, 67 days at $2.50 per day	167 50	
Denison Richmond, division engineer, salary $2,400	850 00	

	Amount.	Total.
Denison Richmond, division engineer, travel	$153 66	
D. E. Whitford, assistant engineer, 130 days at $5 per day	650 00	
D. E. Whitford, assistant engineer, travel	110 57	
R. R. Stuart, leveler	380 00	
R. R. Stuart, leveler	61 30	
		$3,748 01

Incidental Expenses.

Stationery	$49 95	
Fuel and light	46 55	
Postage and telegraph	45 15	
Miscellaneous	294 05	
		435 70
Total for Erie canal		$4,183 71

Ordinary Repairs — Oswego Canal.

David E. Whitford, division engineer, salary $2,400	$100 00	
David E. Whitford, division engineer, travel	9 35	
Denison Richmond, resident engineer, salary $2,000	46 58	
Denison Richmond, resident engineer, travel	8 15	
R. R. Stuart, assistant engineer, 5 days at $5 per day	25 00	
R. R. Stuart, assistant engineer, travel	7 30	
Denison Richmond, division engineer, salary $2,400	384 25	
Denison Richmond, division engineer, travel	68 58	
D. E. Whitford, assistant engineer, 23 days at $5 per day	115 00	
D. E. Whitford, assistant engineer, travel	6 50	
R. R. Stuart, rodman, 12 days at $3.50 per day	42 00	
R. R. Stuart, rodman, travel	4 20	
R. R. Stuart, leveler, 30 2-3 days at $4.50 per day	138 00	
R. R. Stuart, leveler, travel	26 56	
		$981 47

Incidental Expenses.

Miscellaneous		30 00
Total for Oswego canal		$1,011 47

Ordinary Repairs — Cayuga and Seneca Canal.

Denison Richmond, division engineer, salary $2,400	$350 00	
Denison Richmond, division engineer, travel	56 92	

	Amount.	Total.
D. E. Whitford, assistant engineer, 68 days at $5 per day	$340 00	
D. E. Whitford, assistant engineer, travel	67 65	
R. R. Stuart, rodman, 11 3-7 days at $3.50 per day	40 00	
R. R. Stuart, rodman, travel	3 08	
R. R. Stuart, leveler, 55 5-9 days at $4.50 per day.	250 00	
R. R. Stuart, leveler, travel	47 61	
Total for Cayuga and Seneca canal		$1,155 26

ORDINARY REPAIRS — BLACK RIVER CANAL.

David E. Whitford, division engineer, salary $2,400	$100 00	
David E. Whitford, division engineer, travel	14 21	
Denison Richmond, division engineer, salary $2,400	150 00	
Denison Richmond, division engineer, travel	37 24	
D. E. Whitford, assistant engineer, 10 days at $5 per day	50 00	
D. E. Whitford, assistant engineer, travel	6 21	
R. R. Stuart, leveler, 8 1-3 days at $4.50 per day.	37 50	
R. R. Stuart, leveler, travel	4 92	
Total for Black River canal		$400 08

ORDINARY REPAIRS — SUMMARY.

Erie canal	$4,183 71	
Oswego canal	1,011 47	
Cayuga and Seneca canal	1,155 26	
Black River canal	400 08	
Total		$6,750 52

EXTRAORDINARY REPAIRS — BLACK RIVER CANAL.

Making survey for dam in Beaver River.

Act chapter 551, Laws of 1884.

Denison Richmond, division engineer, salary $2,400 per yr.	$26 30
Denison Richmond, division engineer, travel	7 62
D. E. Whitford, assistant engineer, 4 days at $5 per day	20 00
D. E. Whitford, assistant engineer, travel	21 65
R. R. Stuart, leveler, 4 days at $4.50 per day	18 00
R. R. Stuart, leveler, travel	21 15
Total	$114 72

Making plan and directing work for dam in Black River above Forestport Pond.

Act chapter 452, Laws of 1883.

Denison Richmond, division engineer, salary $2,400 per yr.	$39 45
Denison Richmond, division engineer, travel	6 03
Total	$45 48

EXTRAORDINARY REPAIRS — SUMMARY.

Survey for dam in Beaver river.......................	$114 72
Plan, and directing work for dam in Black river.........	45 48
Total..	$160 20

WESTERN DIVISION.

ANNUAL REPORT OF THOMAS EVERSHED, DIVISION ENGINEER, FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1884.

Hon. ELNATHAN SWEET, *State Engineer and Surveyor:*

SIR — In pursuance of the regulations established by act chapter 169, Laws of 1862, relating to the engineer department, I have the honor of presenting to you my report on the Western Division of the State canals, for the fiscal year ending September 30, last past.

Since the abandonment of the Chemung, Crooked Lake and Genesee Valley canals, this division comprises the Erie canal only, which is divided into four repair sections, numbering from 8 to 11, inclusive, as follows:

	Distance in miles.
Section 8 commences east line of Wayne county, ends east line of Monroe county	35·924
Section 9 commences east line of Monroe county, ends at end of construction, section 284	39·624
Section 10 commences end of construction, section 284 ends Sulphur Spring Guard lock	46·560
Section 11 commences Sulphur Spring Guard lock, ends Buffalo incl. Hamburg canal	26·815
Total miles	48·923

The canal slips and navigable feeders are as follows:

	Miles.
Erie canal from east line of Wayne county to Hamburg st., Buffalo	148·92
Five slips in the city of Buffalo	1·60
Genesee river feeder in Rochester	2·25
Total miles	152·77

Unnavigable feeders:

	Miles.
Tonawanda and Oak Orchard feeder	11.55
Genesee valley canal, from Cuba reservoir to old lock No. 87	7·65
Genesee valley canal, from Scottsville to Rochester	11·00
Total miles	30·20

The sources from which the Erie canal receives its water supply, are

1st. Lake Erie.

2d. Tonawanda creek at Pendleton.

3d. Tonawanda and Oak Orchard creek feeder at Medina.

4th. Allen's creek through the disused Genesee valley canal at Rochester.

5th. The Genesee river feeder at Rochester.

The waters of Lake Erie are, however, the chief sources of supply for the whole division.

It enters the canal from the lake through the different slips in the city of Buffalo.

From this city it passes through a canal on the east bank of the Niagara river for a distance of twelve miles to the village of Tonawanda, where it enters the creek of that name near its mouth, from which point it reverses, in times of ordinary stage of water, the natural current of that stream for a distance of twelve miles, when at the village of Pendleton it enters the "Deep Cut," so called, and for a distance of seven miles passes through deep earth and rock cutting to the city of Lockport, where it descends by five locks to what is known as the "Long Level," between that place and the city of Rochester, passing through a country whose slope is very gradual in a northerly direction.

At a point twenty-eight miles east of Lockport it receives the water from the Tonawanda and Oak Orchard feeder, which, however, affords but little water during the summer months, but is quite useful in assisting to fill the canal in the spring.

At Rochester, ninety-three miles from Lake Erie, it receives the water from Allen's creek, which is brought down the disused Genesee Valley canal (now retained as a feeder) for a distance of eleven miles.

To give the railroad company to whom the canal was sold the free use of the bed of the canal in the city of Rochester, they were allowed to pass the water of this feeder under the bed of the Genesee river by means of a cast-iron pipe, and empty it into the Genesee river feeder on its east bank near the southern limits of the city.

The supply of this feeder from Allen's creek is about 1,200 cubic feet per minute, and is very constant during the summer months.

Besides the above amount of water thus passed into the Genesee river feeder, it can be made to furnish a large amount from the river itself by putting flush boards on the dam.

The usual amount, however, at this point is about 1,400 cubic feet per minute, which is derived from a reservoir situated in Allegany county near the village of Cuba.

The objections formerly raised by the inhabitants of that portion of the city of Rochester through which this feeder passes, on account of its supposed unhealthfulness, have subsided since the clear water from Allen's creek has been passed through it.

The bank of this feeder on the river side is low; it should be raised, strengthened and rip-rapped in some places to prevent the possibility of flooding a portion of the city. The estimated cost of doing this is $12,000. It could best be done by dredging out the bottom, and placing the materials on the bank, which would at the same time destroy the aquatic plants now growing in it.

The Cuba reservoir mentioned above, or, as it is sometimes called, the Oil creek reservoir, formerly supplied the summit level of the Genesee Valley canal.

The area of water surface when full is about 600 acres.

The dam which holds back this large amount of water is 2,200 feet in length, and is sixty-five feet in height where it crosses the original channel of the stream.

The water is conveyed through this dam by means of two cast-iron pipes of twenty inches diameter. From these pipes it is conveyed in a short feeder into the old Genesee Valley canal, here retained as a feeder northward as far as the Rockville reservoir(now disused), about seven and one-half miles distant, at which point it is turned into a creek, and finds its way into the Genesee river, and by that means to the head of the Genesee river feeder at Rochester.

At a point about two miles from the above described dam is a waste weir 110 feet in length, over which the spare waters of the reservoir when it is full escape into a ravine, and thence find their way into the Oil creek, a short distance below the village of Cuba.

Last spring a small leak was discovered at one end of this waste weir; it was temporarily repaired at the time, and since the water in the reservoir has been drawn down it has been thoroughly repaired, and the embankment, which had become impaired at this point, has been strengthened and rip-rapped in a thorough manner.

The Rockville reservoir, which was also used for the supply of the Genesee Valley canal, is still retained by the State, but is not used for storing water. It has been found to be necessary to raise the embankment at a small expense to prevent its being carried away in case of an extraordinary flood; this has been accomplished this fall.

The Consumption of Water.

The amount of water made use of on this division was treated on at length in my report of 1880; at that time east of Rochester it was very great; it was very much reduced thereafter; by following the suggestions made by me at that time, which were to see that the mill owners at Newark who make use of the surplus water got no more than could be readily spared, namely the amount in excess of the lockages necessary to supply the evaporation and filtration below that point, and that they made use of it, both night and day, a few hours at a time, and not all of it at any one time which floods the level below in a greater degree than is necessary, and to restrain the lock-tenders from using any more water in drawing boats into the locks and flooding them out again than is absolutely necessary, by following the rule that the lower paddle should not be opened until the bow of the descending boat is in the very jaw of the lock, neither should the water to flush it out be used any longer than is required to pass the stern beyond the lower mitre-sill.

Before these requirements were made on the lock-tenders, I found more water used for these two objects than it took to fill the locks. They should be at all times strictly enforced, as by this means much water is saved and delays to boatmen avoided.

The mitre-sill of the Clyde lock is six inches higher than that of the Port Byron lock; to keep the water up to seven feet in depth, on that of the Clyde lock gives a greater surface descent than is required, and a greater flow than is necessary is the consequence; the banks on the Montezuma level should therefore be raised sufficiently to allow of the sides of the aqueducts which act as spillways being raised to correspond to the Clyde lock; this would at the same time facilitate the entrance of eastern-bound boats into the Port Byron lock by giving six inches more water between the bottom of the boat and the mitre-sill, and would also save bottoming out the canal at the western end of the level which is now needed to a considerable degree.

The material for raising these banks could be best procured by dredging out a portion of the bottom of the level where the material is of a good quality.

The growth of eel grass on the long level between Lockport and Rochester seriously impedes the passage of the water.

There is only one way to effectually cure this evil and that is to thoroughly bottom out that portion of the canal, either by hand or dredge boat. In my report of 1881, I gave the result of the latter method as practiced on the Illinois canal; in view of the large amount of silty matter which has accumulated in the prism of the canal on this division, and the difficulty of procuring men during the very short spring-time season intervening between the breaking-up of the frost and the opening of navigation on the canal, it would seem to be very desirable to adopt some such plan on this canal as has been so successfully used on that of Illinois.

Dams.

There are three dams proper on this division, besides the two on the Oil creek reservoir before described.

First. That across the mouth of the Tonawanda creek near its mouth. It is composed of trees, brush and gravel below with a course of square timber work on top forming an apron; it is 112 feet in length; there are flush boards on the top which brings the water up to the canal level, and are let down in case of floods, the total rise being about four feet. It has also at the north end a bulk-head containing twelve gates, four by five feet each, which are raised in times of floods in the creek. It is in excellent condition, having been thoroughly repaired in 1881.

Second. The Tonawanda and Oak Orchard feeder dam across the Tonawanda south of Medina. It is of the same character as that near its mouth. It is 150 feet long and raises the water about three feet, sufficient to throw the current through an artificial feeder into the channel of the Oak Orchard creek. It is also in good condition.

Third. The Genesee river feeder dam situate at Rochester. It is 510 feet in length, is built of timber and plank on a rock foundation; it has eight wooden piers in the center of the stream which allow of the passage of the water between them as though no dam existed; these spaces are filled in in a temporary manner whenever it is required to use the water for feeder purposes; the object being to prevent the overflow of lands above as much as possible during high water in the river. Four of these piers are decayed and should be rebuilt, the rest of the dam requires to be planked over; the embankment on the west end should be raised and the front rip-rapped ; some repairs are also needed on the masonry which should also be pointed up. The estimated cost of these repairs is $2,800.

Locks.

There are twenty-three locks on this division besides the weigh lock at Rochester.

Fourteen double lift locks 110 by 18 feet in the chamber with various lifts as follows :

No. lock.	Location.	Lift in feet.
53.	One and one-fourth miles west of Clyde	4.755
54.	At lock Berlin	7.360
55.	In the village of Lyons	6.251
56.	"Poor-house" one and one-tenth miles west of Lyons,	9.848
57.	In the village of Newark	8.028
58.	In the village of Newark	8.004
59.	In the village of Newark	8.002
60.	Eight-tenths of a mile east of Macedon	9.886
61.	In the village of Macedon	6.601
62.	Two and a quarter miles west of the village of Pittsford	8.807
63.	"Millers" in the village of Brighton	8.719
64.	"Sipples" in the village of Brighton	10.108
65.	"Reservoir" in city of Rochester	10.102
66.	"First lock" in city of Rochester	8.859
67–71.	Five double combined locks in the city of Lockport.	57.427

One guard lock at Sulphur Springs, above Lockport, has chamber 110 x 20 feet, with two additional head gates of similar character to lock gates. These as well as the lock itself usually stand open, being only shut when there is a flood in Tonawanda creek and during the winter season.

One "river lock" at Tonawanda village, a lift lock (single) connecting the Niagara river with the canal. The rise is generally about four feet, dependent on the height of the water in the river.

One double chambered guard lock at Black Rock 112 x 20 feet. The lift, together with the fall in the harbor, is generally about two and a half feet, varying with the stage of water in the lake.

Taking low water, as per United States engineer record, it is 2.425

Total lift........ 175.182

By adding to the above lift the surface descent on the different levels, we get the total rise on the division.

On the Montezuma level, between the Richmond aqueduct over the Seneca River and the lock at Clyde No. 53, there is 0.524 at present, which is 0.328, or four inches too much, there should be........ 0.196

On the "Twelve-mile" level between locks Nos. 59 and 60. 0.165

On the "Seventeen-mile" level between locks Nos. 61 and 62........ 0.343

On the "Three-mile" level between locks Nos. 62 and 63 .... 0.063 0.063

Location.	Lift in feet.
On "Long level" between Rochester and Lockport, locks Nos. 66 and 67	3.165
On level between Lockport, lock No. 71, and Black Rock guard lock	1.239
Total rise going west	180.353

Weigh Lock.

There is one weigh lock in the city of Rochester. It is in good condition, except the tumble gate at the west end, which requires renewing. It is not now used for weighing, but is sometimes used by sinking boats.

Repairs to foundations were made last spring to the following locks: In 56, 57, 58 and 65 the foundation plank were taken up either in whole or in part, and the spaces between the timbers refilled with concrete.

The plank were taken up and replaced by new, and the locks made tight in lock 59 and the Lockport locks.

In the River lock at Tonawanda the lining was renewed and timbers placed across the lock every two feet apart and heavily bolted to the foundation timbers below to keep the plank from rising, so that the lock can now be pumped out at any time without recourse to cofferdams at each end which have been required hitherto.

New mitre-sills were inserted in locks Nos. 57, 59, and at locks Nos. 56, 60, and the River lock at Tonawanda; the mitre-sills were faced with new timbers for the gates to shut against.

The following locks were pointed up with Portland cement last spring: 53, 54, 55, 57, 58, 59, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71 and the River lock at Tonawanda.

The gains were cut afresh to receive the stop timbers in the following locks: 62, 63, 64, 65, 66 and 71.

New ones were made at each end of the river lock at Tonawanda of sufficient size to receive stop timbers to take the place of coffer dams.

A new breast-wall was built at the head of lock 65 to prevent leakage.

The wing-walls at the foot of the locks at Lockport were found to be very much undermined; they were thoroughly repaired and underpinned.

A new tumble gate was put in lock 60.

New sets of gates were inserted in locks 56, 60, 67, 68, 71 and guard lock at Sulphur Spring. At river lock, Tonawanda and the guard lock at Black Rock, two sets each.

New paddles were inserted in the gates of locks 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65 and 66.

The foundations to the following locks need repairs by grouting between foundation timbers and renewal of planking: 54, 56, 59, 60 and 64.

New mitre sills are needed at locks 57 and 60.

The following locks require repointing: 53, 56, 60, 61, the guard locks and the ship lock at Black Rock. In the latter a good many of the coping stone have been thrust back by the concussion of the heavy vessels passing through it, and other stone have been broken up from the same cause; they should be replaced and renewed.

The gains should be recut in the following locks to receive stop timbers, the stone having been worn away so as to obliterate them: 53, 54, 55, 56, 57, 58, 59, 60, 61.

At lock 60 the centre wall on the north side requires to be taken up and relayed for some distance below the upper hollow quoin and down about six feet.

Some of the coping on lock 71 has become decayed; they should be replaced.

New lock gates are needed, one pair each, at locks 54, 55, 57, 60 and 65, and two pair at the guard lock at Black Rock; one of the guard gates at Sulphur Spring also requires renewal.

New tumble gates are also required at locks 53, 54, 58 and 64, and two at lock 56, and one repaired at lock 60.

Quite a number of new balance beams are required on the division, and forty-five new paddles at locks 53 to 66. The loss of water in consequence of leakage through and around the paddles, and between the mitre sills and the gates, is a serious impediment to navigation, as it hinders the drawing in of loaded boats going west. The rendering of these tighter deserves increased attention. I would recommend the replacing of all the old wrought-iron paddles with those of wood and iron combined as soon as possible; also the renewal of the mitre sills when worn away by the action of the water. I would suggest facing them with heavy angle iron.

The mitre sills of the Lockport locks, originally of stone, have become split in many cases. It would be well to replace the stone with wood, or wood and iron combined.

Aqueducts.

There are four on this division, viz.: one each at Lyons and Palmyra, both of which have wooden trunks, and one each at Rochester and Medina, both of which are wholly of stone.

The one at Lyons is in good condition; in that at Palmyra the floor timbers are very much decayed; they should be replaced by new ones. Of the Rochester aqueduct I beg to repeat what I have already said in my former reports, viz.: that it should be repaired by having its bottom covered with a coating of cement mortar or asphalt to replace one of a preparation of tar put on it some years ago, and which has long since been decayed and valueless for the purpose for which it was intended. Estimated cost, $2,800.

The aqueduct at Medina should have the earth removed from behind the parapet walls and over the trunk, when it should be grouted up thoroughly and pointed; some concrete and other masonry as well as puddled clay will be needed. Estimated cost, $550.

Both these aqueducts should be attended to at once, or they will become seriously injured by frost and other causes.

Waste Weirs.

There are twenty-four on this division. They have been made to agree with the surface levels of, and serve to regulate the, flow of the water throughout the division. They are for the most part in good condition.

The wood-work on those at Newark, Johnson's creek and Maybee's was renewed last spring; the masonry on the two last was relaid.

The wood-work of the following requires to be renewed: Clyde, Lock Berlin, Brockville, Middleport, Medina and Lockport. The masonry also to be relaid in part and the rest pointed up as well as those on the three-mile level and at Brockport.

Bridges.

There are 217 bridges on this division which belong to the State over the Erie canal and slips in Buffalo. Of these, 206 are of single span, one has two spans, four have three spans, three are swing bridges and two are wooden draw bridges over slips.

There are three lift bridges owned by the city of Rochester, viz.: Allen, Brown and Lyell streets.

There are also three wooden truss bridges over the State ditches in Tonawanda village and five of iron in or near the same village, one iron road bridge over the Oak Orchard creek feeder and one iron road bridge over the old canal at Knappville.

There are also fifty-two small bridges spanning the State ditches in Niagara and Erie counties.

The following bridges have been renewed entirely of wood during the present year: Nos. 7 and 168, the latter of three spans situate at Sulphur Spring guard lock.

Nearly all the bridges on the division have had repairs made on them, notably: 60, 72, 76, 103, 108, 119, and nearly all the bridges in the cities of Buffalo and Rochester have been planked over anew.

At the following places old wooden bridges have been replaced by iron ones:

No. 27, Peakes, one mile west of Newark, by one from Horseheads on the Chemung canal, lengthened by the insertion of two panels.

No. 170, across the old canal at Pendleton, with one fitted over from one of the spans of the Ischua aqueduct on the Genesee Valley canal.

No. 112, at county line between Orleans and Niagara, by one composed of one truss from Lyell street, Rochester, supplemented by a new one.

The following wooden bridges will have to be rebuilt during the coming fiscal year: Nos. 28, 51, 91, 132, 134, 151, 142, 149 of one span and 173 of two spans; 44, 45 and 57 which have lower chords of iron will require rewooding. No. 100 will be replaced with an iron one now in the State yard at Rochester.

Plans for an iron bridge to take the place of a temporary wooden one at Louisiana street, in the city of Buffalo, over the Hamburg canal, have been prepared.

Plans are being made for an iron tow-path bridge over the mouth of the Scajaquada creek, in Buffalo, to be erected before the opening of navigation next spring.

An iron bridge is to be erected at Prospect street, Medina, by special enactment by the Legislature; it will have a span of 100 feet; plans for which have been prepared.

Repairs are needed to the trusses of the iron bridges Nos. 18 and 30, and to the following wooden bridges: Nos. 5, 15, 33, and to No. 163, Main street, Lockport, a large wooden structure now much decayed.

The iron bridge at Hamilton street, Buffalo, No. 190, is too low; as it is frequently struck by light boats, it should be raised fifteen inches.

The swing bridge over the slip to the Ohio basin in Buffalo is very much out of order; it requires considerable work on both masonry and turntable, as well as the superstructure itself.

A much decayed wooden bridge over the State ditch at North Tonawanda should be replaced by a rubble stone arch, the cost of which I estimate at $2,100, after which no further expense would have to be incurred for repairs.

Masonry of Bridges.

The stone for new abutments are on the ground to take the place of bents, which are much decayed at bridge No. 45, in the village of Fairport; estimated, $400.

New abutments will have to be constructed for the road bridge over the Tonawanda creek at Pickards, No. 174; estimated, $900.

New abutments must also be built for the new tow-path bridge over the Scajaquada creek, Buffalo; estimated $800.

Repairs to Masonry.

I beg leave to report what I have mentioned in my former reports in relation to the unfinished condition of the berme abutment of the Culver road bridge No. 62, in the city of Rochester, in which the wings are entirely wanting. The embankment is quite narrow in consequence and dangerous; estimated cost $450.

Nearly all the abutments on the division require repairs, the whole of which I estimate at $5,500.

Piles should also be driven to protect some of them from being damaged by boats under the action of heavy winds.

Culverts.

There are 136 culverts of various kinds on the division.

No. 2, near Pitt lock, has a wooden trunk which has been allowed to become dry; it has decayed in part; it is to be repaired before the opening of navigation next spring.

No. 36, on the three mile level, is of the same character; it is much decayed; it should be replaced by stone masonry or iron pipes, which would be preferable, as the foundation is in quicksand; estimated cost of pipes, $4,700.

The culvert leading from the back ditch to the canal on the mountain ridge west of Lockport at Murphy's farm, has given way; it should be repaired at once; estimated cost, $750.

A small culvert under the Genesee river feeder in Rochester has given way; it should be replaced by a wooden trunk; estimated cost, $350.

The masonry of all the culverts on the division require more or less repairs; in many the wing walls and parapets have been entirely thrown down by the frost; they should be replaced, and should have broken or field stone placed behind them as a protection from the action of the frost in the future. Estimated cost of all such repairs, $6,000.

Stop-gates.

There are six stop-gates on this division, viz.: at Bushnells basin and Cartersville, on each side of the heavy embankments of the Irondequoit; one at Adams basin, two near Holley, one on each side of the heavy embankment at that place, and one near Medina.

The following repairs were made last spring: The wood work of those at Medina, East and West Holley were rebuilt, and the masonry and wooden piers repaired. The wood work of that at Adams basin requires to be renewed and the masonry laid over with additional stone work; estimated cost, $300.

Vertical Wall.

The vertical walls on this division are very much out of order, especially in Buffalo, Rochester and Albion. The elements during the time which has elapsed since they were built, and the imperfect manner in which they were constructed, have had the effect which may be expected on such structures. When they are repaired they should be taken down entirely, fresh stone of a better quality than those originally used added, and such alignment made use of that when in course of time all have been rebuilt they will present a uniform and proper appearance.

Last spring about 150 feet of slope wall was taken down at the bend just east of the Lyons lock, and vertical wall of excellent quality substituted therefor, an improvement which has long been needed; about 250 feet more will be laid over next spring, the stone being on the ground therefor.

About fifty feet on each end of the Palmyra aqueduct on the berme side of the canal should have a twisted wall from vertical to slope, constructed of good flat bedded stones to insure the same against future breaks.

A piece of vertical wall on Commercial slip has fallen into the canal; it should be rebuilt with heavy stone and should have a good pile foundation with sheet-piling behind it as is usual in the locality.

Slope Walls.

The slope walls on the long level between Rochester and Lockport are very much out of shape by the action of frost on the peculiar soil, a mixture of clay and quicksand, through which the canal passes.

Sheet Piling.

The sheet piling on the heavy embankment over the Irondequoit was very much decayed; the greater part of it above canal bottom was replaced by new plank last spring, it is proposed to replace the rest next spring.

Canal Banks.

In several places on this division weak places occur from various causes, and low places occasioned in some instances by the settlement of the banks exist. These should be strengthened and raised, notably the Montezuma level, where the raising the banks would serve two purposes, the saving of the expense of bottoming out and giving more space between the bottom of the boats and the bottom of the aqueducts and the mitre sill of the Port Byron lock.

Towing Path.

Considerable improvement has been made this year in the state of the towing path, especially on Tonawanda creek where it has been faced with stone for several miles, the stone having been purchased from the contractor on the Buffalo sewer which lay near the canal and came in very usefully for this purpose.

Prism of the Canal.

The usual amount of work was done last spring in removing matter of various kinds from the canal bed; on section eight much more was performed. As I have hitherto mentioned, this does not keep pace with the accumulation, and other means must be resorted to.

The harbor, canal, basin and slips in the city of Buffalo require also constant dredging, as well as that portion of the canal between Black Rock and the Sulphur Spring guard lock, a distance of 25 miles.

About two years ago I had soundings taken and a map made showing the amount of dredging then required to restore the canal, harbor, basins, etc., in the city of Buffalo; it amounted to 185,000 cubic yards. This has arisen in a great measure from two causes — one the constant emptying of all the sewage matter of the city of Buffalo into the canal, which, floating down, tends to fill up not only the canal and harbor in Buffalo, but extends to the canal itself to a distance far below Lockport. Another cause is the dumping of the material dredged from the harbor and slips, etc., in the city of Buffalo so far to the southward that the westerly gales drive it inside the Black Rock or Bird Island pier. I think that action should be taken on the subject of a proper dumping ground that would not interfere with the keeping the canal and harbor clear of this deposit.

Bird Island Pier.

Three pieces of the extension of this pier were carried away last fall by heavy storms; it was thoroughly repaired this summer. That portion has been filled in front with heavy stone to act as a protection to the crib work.

Erie Breakwater.

No work of any consequence has been done on this pier this year; it is in fair condition. Like all this kind of structures a good deal of labor could be laid out on it to advantage.

NAVIGATION OF 1884.

A break occurred on the morning of June 25th just east of the Palmyra aqueduct, which carried away the berme bank for some distance from that structure and washed out the bottom of the canal for about 300 feet. A boat loaded with wheat was caught in the break, one end resting on the aqueduct; it was removed by burning it up, and the break repaired and navigation was fully resumed July 3d.

A small break occurred on October 29th on the Three-mile level which detained navigation only a few hours, however.

With these exceptions, although quite a number of heavy leaks have occurred and been stopped, no detention of navigation has occurred during this season's navigation thus far.

Buffalo Trunk Sewer.

The commissioners intrusted with this work have made good progress therewith. It will probably be completed by early spring, with the exception of the outlet into the Niagara river. The tunnel under the canal is completed; the contractors are now at work on that portion in the harbor which requires a coffer-dam, and which, owing to the depth of water, cannot be tunnelled, after completing which they will connect each end of a coffer-dam, which will run lengthwise the harbor, with the Bird Island pier; remove it and form the sewer outlet into the river, when they will replace the pier as to alignment with heavy stone work instead of cribs of timber filled with stone as at present.

This work is situate at Albany street.

To make the work complete, the dry-weather flow of the other large sewer of Buffalo, viz., that which now empties all its contents into the canal at Bird avenue, is to be brought along the rear of the towing-path in a four-feet brick sewer to the same tunnel at Albany street, where, mingling with the main trunk sewer, the contents of each will flow into the Niagara river.

Although but little more than the dry-weather flow is intended to be conveyed by these sewers into the river, it is to be hoped that they will have the desired effect of relieving the canal from the inordinate amount of sewage matter which now flows down its channel, and settling, forms such an obstruction to navigation in itself and furnishes a bed for the growth of aquatic plants, which still further interfere with the flow of the water, and which, even as far down as Middleport, has been a subject of complaint on account of its stench.

I have had the honor, at your request, of taking charge of the drainage of the State Asylum for the Insane, at Buffalo; reflooring the basements and laying a track for the conveyance of the food to the different wards.

It has been let and the work is now in progress.

This division has been under the charge of Thos. Evershed, as division engineer, during the past fiscal year.

I have the honor to be

Your obedient servant,

THOS. EVERSHED,

Division Engineer.

Statement giving names, rank, number of days and compensation of engineers upon the repairs of the Western Division of the New York State canals, with incidental expenses, during fiscal year ending September 30, 1884.

[Act, chap. 169, Laws of 1863.]

Erie Canal.

Repairs from Oct. 1, 1883, *to Sept.* 30, 1884.

	Amount.	Total.
Thos. Evershed, division engineer, 11-12ths of a year, salary $2,400	$2,200 00	
Thos. Evershed, division engineer, expenses	453 63	
Jno. Bisgood, resident engineer, 1-8 of a year, salary 2,000	250 00	
Jno. Bisgood, resident engineer, expenses	8 03	
Jno. Bisgood, assistant engineer, 250 days at $5 per day	1,250 00	
Jno. Bisgood, assistant engineer, expenses	143 14	
W. N. Radenhurst, assistant engineer, 40 days at $5 per day	200 00	
W. B. Sackett, leveler, 39 days at $4.50 per day.	175 50	
W. B. Sackett, leveler, expenses	19 44	
M. W. Wilbur, rodman, 79 days at $3.50 per day	276 50	
M. W. Wilbur, rodman, expenses	10 48	
M. W. Wilbur, chainman, 195 days at $2.50 per day	487 50	
M. W. Wilbur, chainman, expenses	104 50	
A. Van De Mark, chainman, 88 days at $2.50 per day	220 00	
A. Van De Mark, chainman, expenses	7 98	
		$5,806 70
Stationery	$53 57	
Fire, light and office rent	407 20	
Postage and telegraph	64 06	
Miscellaneous	21 92	
		546 75
Total		$6,353 45

The following amount of work and travel has been done by the regular engineering force on this division, outside of their regular duties, on ordinary repairs during the last fiscal year.

	Amount.	Total.
T. Evershed, division engineer, 1-12th the year, salary $2,400	$200 00	
T. Evershed, division engineer, expenses	33 93	
John Bisgood, assistant engineer, 25 days at $5 per day	125 00	
John Bisgood, assistant engineer, expenses	26 42	

	Amount.	Total.
M. W. Wilbur, chainman, 40 days at $2.50 per day	$100 00	
M. W. Wilbur, chainman, expenses	36 07	
Total		$521 42

Report on the work done pursuant to a concurrent resolution of the Legislature relative to the establishment of bench marks to fix and determine the level on Cayuga and Cross lakes.

The resolution is as follows :

WHEREAS, Several embankments have been made across the outlet of Cayuga lake and the channel of Seneca river, by the State, railroad companies, and public and incorporated bridge companies ; and

WHEREAS, There are no established levels or marks to determine the effect from year to year of these works upon the relative water level of Cayuga lake and its outlet.

Resolved (if the Assembly concur), That the State Engineer be and he is hereby directed to run a line of continuous levels from Cayuga lake to Cross lake, establishing bench marks at high water-mark along the line of said levels as follows :

Bench-mark No. 1 to be established at high-water mark on the lower mitre-sill of the lock at the entrance to the Cayuga branch of the Cayuga and Seneca canals which show the level of the Cayuga lake.

Bench-mark No. 2 shall be established at high-water mark on the lower mitre-sill of what is known as mud lock at junction of the Seneca branch, with the Cayuga branch of said canals.

Bench-mark No. 3 shall be established at high-water mark on the central pier of the Erie canal aqueduct at the crossing of the Seneca river.

Bench-mark No. 4 shall be established at high-water mark at the central pier of the crossing of the New York, West Shore and Buffalo railroad.

Bench-mark No. 5 shall be established at high-water mark on the central pier of the New York Central and Hudson River railroad companies' crossing.

Bench-mark No. 6 shall be established at high-water mark at the cut through Musquito point bar.

Bench-mark No. 7 shall be established at high-water mark at the water level of Cross lake at a suitable place in the discretion of the engineer in charge.

All of the above bench-marks shall be established at high-water mark and marked on the map of the outlet of the Cayuga lake; and in the channel of Seneca river so that they may be easily found and noted by an expert in engineering. Said map is now on file in the office of the State Engineer.

It shall be the duty of the State Engineer, three times in each year, namely during the first ten days of each March, August and December, to detail an engineer to examine and report to his office the relative condition of the water-level as compared with the above established benches.

Also to report upon the actual depth of water at the point where these bench-marks are established.

Also to take the actual water-level at the point each side of the Erie canal embankment where the old channel of the Canandaigua or Clyde river is crossed by said embankment. The result of the above levels and measurements shall be published annually in the report of the State Engineer to the Legislature, and in the event that the Department of the State Engineer shall be abolished or absorbed by any other department, the duties above detailed shall be performed by the department succeeding to that of the State Engineer.

The work of carrying out these requirements of the Legislature was intrusted to Denison Richmond, division engineer of the middle division of the State canals, who makes the following report:

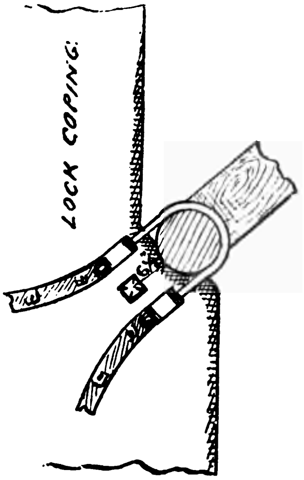
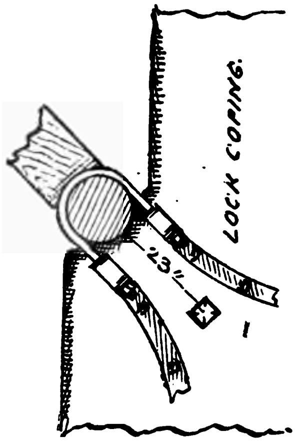
The foregoing resolution requires the bench marks to be established at high-water mark, and at the same time, in most cases, designates the particular places where they shall be made. To fulfill these requirements literally was found to be impossible, but the benches as now established will furnish all the data required by the resolutions. The values given at these benches refer to the base or datum line established by Hon. George Geddes in 1851. This course was adopted, as testimony given by canal engineers since that time before the Board of Appraisers, was based on the values of benches derived from said base. While all future records and water profiles can hereafter, on this basis, be more readily connected and compared with those on file, the datum line referred to was made $8\frac{137}{1000}$ feet above the surface of Cayuga lake, as found October 1, 1851, and at that time established by three benches cut in the face of the rock at Cayuga. In State Engineer's report for the fiscal year ending September 30, 1862, page 357.

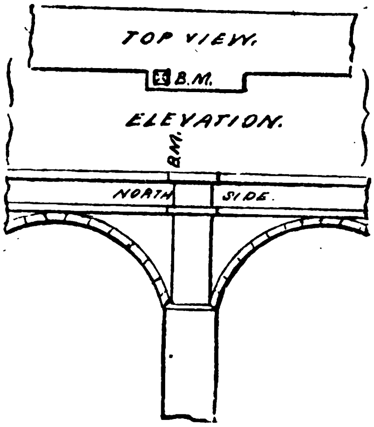
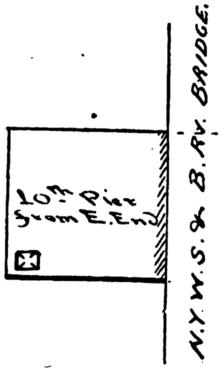
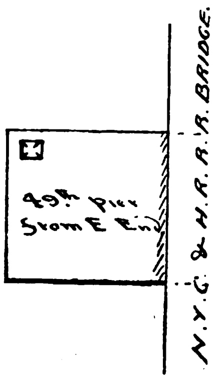
These benches, owing to the disintegration of the rock, are now obliterated; but in 1862, other benches along the river were established from these by Howard Soule, Jr., and were used in connection with the present line of continuous levels. The bench on the Montezuma aqueduct was in the best state of preservation and the most permanent, being in a position least liable to disturbance by frost or accident. This was therefore made the connecting bench, although the variations at some of the other benches were so slight as to have made no practical difference which was selected. Great care was observed in running the original line of levels; but to prove the work a test was made, the result of which was most satisfactory. The entire work, including test, required about fifty miles of careful leveling, and was done without the employment of extra help. It involved considerable time and expense, and to take the required measurements three times each year will take about nine days, as the points are so widely separated and difficult to reach.

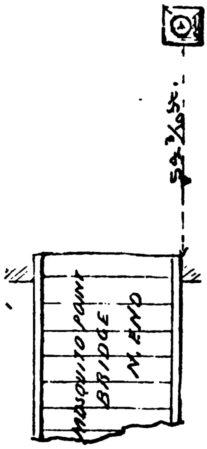
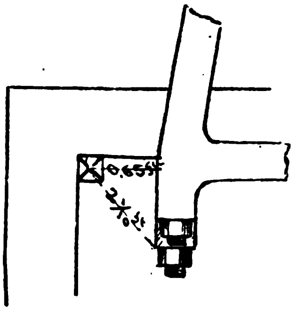
Following is a description of the benches which are also marked and graphically described on the map indicated in the resolution. I have also appended a table showing measurements to date as required, and also the principal data bearing upon the subject compiled from the records in this office and reduced to the common base as adopted. These were prepared by Mr. D. E. Whitford, who was in charge of the work done under the appropriation of 1872 and 1873, and is therefore familiar with the old benches and the records of high and low water for the past ten years.

Bench marks established in 1884 between Cayuga and Cross lakes in accordance with a concurrent resolution of the Legislature.

These bench marks refer to the datum line established by Hon. George Geddes in 1851.

Value.	Location sketch.	Description.
No. 1. —0·008		On coping between the anchor irons, six and one-half inches from the T. P. or west lower hollow quoin, Cayuga lock.
No. 2. —0·234		On coping between the anchor irons, 23 inches from the berme or south lower hollow quoin, East Mud lock.

Value.	Location sketch.	Description.
No. 3. +6.049		On coping of parapet wall, N. E. corner of projection, over 15th pier from east end, Seneca river aqueduct.
No. 4. —4.799		S. E. corner, coping, 10th pier from east end, New York, West Shore & Buffalo R. R. bridge.
No. 5. —4.687		S. W. corner, coping, 49th pier from east end, south track, New York Central & Hudson R. R. bridge.

Value.	Location sketch.	Description.
No. 6. —0.336		Centre of gray limestone monument, E. side of highway, $54\frac{3}{10}$ feet northerly from northeast corner, and in line with E. side of Mosquito Point bridge.
No. 7. —6.059		West corner of stone, supporting south end of west truss, $\frac{65}{100}$ of a foot from side, and $2\frac{1}{10}$ feet from end of truss casting, iron road bridge, one mile west of Cross lake.

Water record of Cayuga and Cross lakes and Seneca river, as per concurrent resolution, 1884.

[Water surface given below datum line.]

LOCATION.	Bench mark. No.	Miles from Cayuga.	August 5th, 6th and 7th. Water.		December 2d, 3d, and 4th. Water.		REMARKS.
			Surface.	Depth.	Surface.	Depth.	
Cayuga lake........	1	....	—8.59	10.49	—10.11	8.97	Depth on lower mitre-sill.
Mud lock...........	2	1½	8.80	10.42	10.22	9.00	Depth on lower mitre-sill.
Erie canal aqueduct.	3	6½	11.42	7.03	12.98	5.47	Depth on aque't foundation.
Canandaigua river, south of Erie canal.	....	6½	11.20	5.60	12.86	4.00	Depth of river.
Canandaigua river, north of Erie canal.	....	6½	11.58	5.40	13.01	4.00	Depth of river.
N. Y., W. S. & B. R. R. crossing.......	4	9	11.85	3.75	13.20	2.40	Depth on natu'l bed of river.
				7.80	....	6.50	Depth in channel dredged.
N. Y. C. & H. R. R. R. crossing.......	5	10	12.41	4.80	14.19	3.00	Depth on bridge foundation.
Mosquito Point.....	6	15¼	15.92	0.10	16.81	Bed dry.	Depth on natu'l bed of river.
				7.20	....	6.30	Depth in channel dredged.
Cross lake..........	7	25	17.32	19.20	17.55	19.00	Depth at iron bridge.

Water record of Cayuga and Seneca lakes and Seneca river, compiled from records in Division Engineer's office at Syracuse, N. Y. (*December,* 1884.)

[Water surface given below datum line established by Geddes in 1851.]

LOCATION.		Miles from Cayuga lock.	October 1, 1851.	August 25 and 26, 1862.	Highest water known. March 19, 1865.	Highest water known. April 10 and 11, 1873.	May 25, 26 and 27, 1875.
Cayuga lake.....................		......	—8.14	—7.03	—2.70	—2.71	—9.26
Mud lock at T. P. bridge....	up-stream side.....	......	8.31	7.16	3.28	2.62	......
		1½					
	down-stream side..	......	......	......	......	2.79	......
Seneca River aqueduct....	up-stream side.....	......	......	......	3.78	3.89	......
		6½	10.78	10.76	......	......	11.58
	down-stream side..	......	......	......	3.87	3.49	
Canandaigua river, south of Erie canal..........................		6½	......	......	3.58	3.20	......
Canandaigua river, north of Erie canal..........................		6½	......	......	4.11	3.55	......
N. Y. C. & H. R. R. R. crossing....		10	11.80	12.12	......	......	12.69
Mosquito Point.	head of bar.......	......	12.63	14.20	......	3.81	14.61
	at bridge.........	15¼	.....	......	......	3.94	......
	foot of bar........	......	13.12	14.78	......	4.08	15.00
Cross lake.......................		25	13.98	17.95	......	6,09	15.93

tractor for 28,000 cubic yards, more or less (estimated), at seventeen cents per cubic yard, from which 30,068.40 cubic yards of material was removed. Also for Esopus creek at Saugerties with E. R. Seward, contractor, 25,000 cubic yards, more or less (estimated), at eight and three-fourth cents per cubic yard, from which 29,131 cubic yards of material was removed. Considerable work was also done by State Dredge No. 2, on the Overslaugh at the end of the Albany Pier, at Troy, and in taking out a sunken boat at nine mile tree, in all about thirty-seven days, which work was not of sufficient magnitude to warrant the letting of contract for, and which was paid for by the number of hours' service actually performed. I would respecfully call your attention to the extremely low prices for which all the contracts were taken the past year, and though the Hudson River Improvement Fund shows a balance of $8,524.97 that if taken in comparison with prices for which the same class of work has been done in former years, would show a deficit, and as the several bars or shoals of the Hudson river accumulate steadily and require constant attention to preserve navigation, it would be unwise to recommend a decreased appropriation for its improvement. I would also submit to you the engineering expenses for the past season amounting to $3,484.32 which for detail, I would refer you to the accompanying statement.

Yours respectfully,
CHAS. G. WITBECK,
Asst. Engineer in charge of the
Hudson River Improvement.

Report of Disbursements by the Engineering Department of the Hudson River Improvement for the year 1884.

MONTH.	Salary of corps.	Travel and hotel exp'nses.	Office expenses.	Material.	Labor.	Wages of boatmen.	Use of small boats.	Tug hire.	Total.
April	$158 50	$4 00	$29 88	$9 82	......	....	$3 63	$75 00	$280 83
May	351 00	42 74	20 17	13 34	......	$41 00	28 69	6 25	503 19
June	349 00	2 83	3 56	2 42	......	32 00	13 00	......	403 31
July	445 50	5 75	......	16 22	......	26 00	13 00	......	506 47
August	355 50	57 42	7 94	1 25	$10 00	46 00	22 00	......	500 11
September	338 00	22 48	......	80	......	10 50	4 00	......	375 78
October	351 00	12 45	......	......	......	20 00	12 00	5 00	400 75
November	237 50	....	......	......	......	....	......	......	237 50
December	199 50	20 69	*17 74	......	29 00	8 25	2 00	......	277 18
Total	$2,785 50	$168 36	$79 29	$43 85	$39 00	$183 75	$98 32	$86 25	$3,484 32

Printing in 1882.